COSMOLOGY

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COSMOLOGY

AN INTRODUCTION TO THE PHILOSOPHY OF MATTER

BY THE

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VOLUME I.

THE GREEKS AND THE ARISTOTELIAN SCHOOLMEN

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He who believes Aristotle to be a god ought to believe that he never made a mistake. But, whoever thinks him to have been a man must admit that he was as liable to make mistakes as the rest of us. ALBERT THE GREAT.

Unless a man holds truth dearer than friends, he will be ready to pronounce false judgments and to bear false witness for the sake of his friends. But that is immoral. All men ought to hold truth dearer than friends because all men have the use of reason. But this duty is particularly binding on philosophers because they profess to teach wisdom, and wisdom is nothing else than the knowledge of truth. . . . Truth is, indeed, divine for it is found fundamentally and primarily in God. That is why Aristotle insists on the sacredness of the duty of holding truth dearer than friends. . . . Plato is of the same mind. For, once when setting aside a theory of his master, Socrates, he declares that truth must be our supreme concern. And elsewhere, he declares: Socrates is, indeed, a friend of mine, but truth is a greater friend. And in a third text, he declares that one may make little of Socrates, but one must make much of truth.

ST. THOMAS.

PREFACE.

THE present volume is an attempt to prepare the ground for a convincing exposition of the strong points of Scholastic Cosmology. The main difference between it and most contemporary treatises on the same topic is a more generous usage of the historic method in the treatment of metaphysical problems: a revival, as the Introduction points out, of the precept and practice of Aristotle and St. Thomas.

The introductory chapter deals with four preliminary topics: the origin in ancient Greece of Science and Philosophy—as synonyms; the emergence in late sixteenth century Europe of Natural Science and Cosmology—as irreconcilable rivals; the subsequent rectification of frontiers, and the resulting chasm nowadays between the ideals of the natural scientist and the cosmologist; the importance attributed by St. Thomas to Cosmology as a basis of Rational Theism. This Introduction is followed by four chapters on Greek Cosmology which explain the rise and the development of Aristotle's Cosmology. The next five chapters are devoted to an exposition of the complex speculative system reared on that Cosmology by the medieval Schoolmen under the leadership of St. Thomas, Scotus, and Suarez. A final chapter tells how this Cosmology was driven from the universities of Europe by the gibes of the Humanists, by anti-Aristotelian discoveries in Natural Science, and—above all—by the break of decadent Schoolmen with the best traditions of their forbears.

A second volume will be published to prove that the resumption, since the Leonine revival, of the older traditions of Aristotelian Scholasticism has resulted in a Scholastic Cosmology which is more in accordance with the assured results of modern science and modern philosophy than any of its contemporary rivals.

JOHN O'NEILL.

MAYNOOTH, *October*, 1923.

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INTRODUCTION.

THE purpose of an Introduction is to put before the beginner a correct preliminary notion of the scope and utility of the information to which his attention is invited. That task is exceptionally difficult in Cosmology. Cosmology is defined as the philosophy of matter. Philosophy is defined as a rationalistic search after ultimate truth. But the beginner whose education has been conducted in accordance with century-old traditions of English-speaking peoples has been taught, in nine cases out of ten, to believe that all the truth worth knowing about matter and its properties is expounded in the various branches of physical science. For him and for his teachers, there seems to be no room in modern times for a philosophy of matter. He and they are naturally slow to admit that there is anything they do not understand in words and ideas which are constantly being used about matter and its properties not only in the textbooks of physical science but also in everyday thought and language. Hence, when the cosmologist begins to ask troublesome questions about the meaning and validity of these common and familiar notions, ordinary practical men, and even many intelligent English-speaking students of modern physics, are apt to complain that he is wasting his own and everybody's time by raising idle and uncalled-for difficulties about the self-evident. The full vindication of Cosmology from this charge of futility can be furnished only by such a critical examination of the actual problems investigated by the cosmologist as can be attempted in a complete treatise. However, I am publishing at the moment only that part of Cosmology which deals with Greek and Medieval speculation. Now, no one doubted the value of Cosmology during the centuries covered by that period of human thought. Moreover, these ancient cosmologists accepted in physical science facts and theories which have been proven utterly misleading. Indeed, these mistakes of the ancients in physical science is—though our beginner may not be aware of the fact—the root of his prejudice about the possibility of a philosophy of matter. That is why I see no way of inclining this English-speaking beginner to give an impartial hearing to the succeeding chapters except by reminding him, at the start, of a few facts about the origin and the historical development of science and philosophy. This project has resulted in an Introduction that certainly runs to an unusual length and apparently includes not a few irrelevancies. Starting from Greek superstition in the Stone Age for

the purpose of arriving at contemporary ideals about the connexion between the science and the philosophy of matter, I have wandered from topic to topic in a fashion that must seem explicable only by sheer crookedness of mind. I am hopeful, however, that the reader shall discover, long before he comes to the end of the chapter, a thread of method running through the maze. I am hopeful, also, that he shall appreciate the need of copious quotations on certain topics. I could, of course, have summarised these authorities. But the points at issue refer to branches of knowledge distinct from philosophy. And on that account, I thought it advisable to quote the actual arguments employed by specialists in these sciences.

The Creation of Rational Science.

The Greeks of the sixth century before Christ were the product of a long series of conquests and of colonisations.(1) Those in the motherland were a blend of Northern or Centro-European invaders with the aborigines of the Greek peninsula : in the third millenium, the first Greeks descended from the Balkan peninsula and conquered these aborigines, imposing on them the Greek language but fusing with them in race and religion ; about the sixteenth century, the Cretans settled on a few coastal spots in Greece, bringing with them a civilisation as ancient and as advanced as that of Babylonia or of Egypt ; about the thirteenth century, the Achæans came and conquered but adopted, in the various parts of Greece, the civilisations of the conquered peoples ; at the end of the twelfth century, the Dorians descended on the peninsula and destroyed, wherever they penetrated, the already existing civilisations. The coming of these Dorians synchronised with the beginnings of Greek colonisation ; Aeolis was founded in the twelfth century ; Ionia, Cyprus, and Doris in the eleventh. And between the eighth and sixth centuries Greek colonisation was completed elsewhere : colonies being planted on the shores of Thrace and the Black Sea, in Italy and Sicily, and even in Spain and Gaul. Thus, by the sixth century B.C., the Greek race had acquired not only its definite instincts and bias but also its widest expansion.

The practical and intellectual ideas of these pre-scientific Greeks in art and literature as well as in life and religion were based on a singularly manifold series of strange myths and stranger rites.(2) There was, despite certain local and unimportant differences, a common and uniform system of mythology and ritual throughout the mother-land and its colonies. Even the most civilised parts of Greece of that date tolerated and welcomed all the myths and all the rites of the Greek pantheon. That pantheon ruled princes and people, thinkers and poets, city-states and tribal communities. It was the main factor in the work and play, the hopes and fears, the affections and antipathies, of all Greeks. At this stage of their civilisation, the

Greeks had not realised the existence of the laws of nature: unless, indeed, their worship of the Fates as sometimes controlling facts independently of Zeus be construed as a faint adumbration of some inevitable sequences in nature. At this stage, the Greeks made no attempt to shape their conduct according to fixed principles of right and wrong: their morality was not yet rooted in the conscious exercise of reason, except in so far as rare advances in the received ancestral code might be construed as a sign of the trend of their ethics towards humanitarianism. Their practice and their theory in every department were guided by folk-legends, temple-legends, poet-legends. Their outlook on nature and on man was governed by fanciful and trivial interpretations of natural events as brought about by preternatural agents. And every day, they performed a number of rites for the purpose of buying the favour or buying off the disfavour of the gods and goddesses of Greek religion.

That religion was an inconsistent medley of nature-worship, animal-worship, ancestor-worship, daimon-worship and Olympian-worship. It was administered at every temple at home and abroad; each temple had its priests who claimed special knowledge of the local god or goddess, and were ready to explain the proper way of winning his or her favour and appeasing his or her anger; sometimes these temple-guardians advocated magic, sometimes natural divination, sometimes inspired divination. Those parts of the worship which dealt with the food-supply and the tribe-supply were, in Greece as elsewhere, obscene and cruel: phallic and orgiastic rites; blood-magic, raw-flesh feasts, human sacrifice, ritual cannibalism. Every part of the worship was superstitious: here, charms and other magical arts were practised in order to compel the divinity to fulfil the desire of his worshippers; there, the will of the divinity was supposed to be made known by natural divination—the rumbling of thunder, the flashing of lightning, the falling of meteors, the clanging of cauldrons, the murmur of streams, the rustling of trees, the cooing of doves, the cries and flights of birds, the swimming of fish, the crawling of serpents, the inspection of entrails, the drawing of lots, the casual utterances of men; elsewhere, the will of the divinity was supposed to be made known by inspired divination—a divine ecstasy falling on a human intermediary who was thought at such moments to be possessed by the deity, and to be capable during this possession of displaying superhuman wisdom. Such were the shrines at which for centuries all Greeks worshipped, with absolute confidence both in the efficacy of the local rite and in the power of the local deity: at those shrines, the helot sought protection, the sick health, the maimed healing, the suffering consolation, the farmer weather and crops and herds, the artisan lucrative employment, the business man trade, the wealthy security and pleasure, the adventurer and the politician success, the artist and the man of letters inspiration and skill. The replies that were given at these shrines varied from

the virtuous to the abominable, from the clear to the ambiguous. The oracles had their good points: they emphasised the sanctity of the oath, the sanctity of family duties, the sanctity of the life of the kinsman: occasionally, they stressed the value of the widow's mite, the need of making allowance for the strength of excessive temptation, the guilt of the murderer. It is possible, moreover, that there was at times a power at work in those oracles greater than any dreamt of in the philosophy of crass materialism or of cocksure rationalism. But, in most cases, the replies were obviously dictated by nothing more than a shrewd opportunism. Each oracle was in fact the mouthpiece in its district of the dominant religious and political interest; and, in such circumstances, the lowest elements in human nature were always tending to come to the top.

Each of these temples was dedicated to one or more of the gods and goddesses sung for Greece by the Homeric and Hesiodic poets. This national poetry was believed both by the loftiest and the lowliest minds in pre-scientific Greece to be absolutely true. The Homeric and Hesiodic Greek believed himself to be constantly and universally surrounded by his racial deities and to be dependent on their co-operation in all his enterprises; and he accepted literally and trustfully every line of the national epics. Homer sings for the courts of princes: his Olympians are the human-nature gods of those Northern invaders, the Achæans. He throws a veil of decency over the orgies of phallicism and blood-magic. He puts some kind of order in the pantheon: Zeus is the father of gods and men. There are times, also, when his poetry strikes a serious religious note: Zeus and the Olympians are on the side of justice and mercy, their displeasure is aroused by those who spurn the voice of prayer or those who injure the suppliant, the guest, the beggar; and there are powers in the lower world who guard the sanctity of the oath and punish the wicked after death. But at other times, Homer tells a different tale: Zeus and his sons are a dissolute crowd of lecherous bullies, Hera and her daughters a jealous crowd of wanton shrews; Zeus beats his wife and suggests her desire to eat Priam, he hurls his son over the battlements of Olympus and pushes other gods from their thrones; his ill-assorted aggregate of sons and daughters lead among themselves the lives of quarrelsome and deceitful idlers; and all the Olympians from Zeus downwards govern the human race by methods of the frankest favouritism. When we turn from the Homerist, the poet of the heroes, to the Hesiodist, the spokesman of the common people, we read a still more appalling account of the Greek pantheon. The coarse and savage superstitions of the helots, which the Homerists disdained or glossed over, are dragged into literature and flaunted as divine truths. The gods and goddesses of Hesiod are for the most part those of the Achæans, but the spirit in which their deeds are told is that of the aborigines of the Greek peninsula. The Hesiodists, also, introduced the era of literary cosmogonies: Hesiod sings

how the world was made, the gods and the earth, the rivers and the ocean, the stars and the heavens ; and some of these myths have never been surpassed for coarseness and savagery.

A deliberate effort of attention is necessary for the modern reader in order to realise definitely that this system of beliefs, so intellectually puerile and so morally contemptible, constituted as late as the sixth century B.C. the whole mental stock-in-trade of the glory which then was Greece. If we analyse the intellectual acquisitions of any Greek of that age we find that, over and above the practical capacity and skill requisite for his daily wants, these acquisitions consisted of various myths dealing with his state, his kinsmen, his festivities, his mysteries as well as with the works of art and the more striking natural objects in his environment—all set off and glorified by some knowledge of the epic poets : an aggregate of religious, patriotic, and social fancies blended into one indivisible creed. Part of that creed was not a whit less childish and barbarous than the religion of Tasmanians or of Bushmen. None of it was any advance on the superstitions of Babylonia or of Egypt. All of it was accepted as objective truth by the rich and the poor, the learned and the unlearned, in every place where the Greek language held sway. The wary student of the psychology of human beliefs need not be told that the mass of the Greek people never, in their pagan days, outgrew these follies. It was so much easier to accept the ready-made world of the oracles and the well-told world of the poets than to jog one's brain about truth that the overwhelming majority of the Greeks, and even of those in Athens, the most civilised city of Greece, were not affected by the enlightenment begun in the sixth century, and remained for centuries afterwards immersed in the superstitions of their forefathers. The fact is that the Greeks who really made a glory of Greece are a chosen few : most of them Ionians and Athenians.

What, then, was the momentous step which once for all lifted Greek civilisation above the savage rites of Tasmanians or Bushmen and above the stifling superstitions of Babylonia or Egypt ? It was the creation of rational science : the self-assertion of human reason against man-made conventions. Thales and his philosophic peers, from about 585 B.C. onwards, gave up believing blindly, either in literary fables about the origin of things or in oracular fables about the activities of things, and originated the method of finding out the origin and activities of things by observation of, and experimentation on, facts and by hard reasoning on these observations and these experiments. This Ionian innovation was to lay an indelible impress on the future progress of mankind. Within three centuries, it changed the course of critical education not only for the Greeks but also for the whole human race. By giving birth in Greece itself to philosophy and science and history, it made that country the cradle-land of all subsequent philosophy and science and history. It reacted also on the art and literature of the Greeks and carried both forward

in a surprisingly short time to that pitch of excellence which fitted them to be humanistic educators of Europe: the new atmosphere of critical enquiry made possible for Greek artists and Greek men of letters an unfettered treatment of the life and traditions of their race. But the most important fruit of this Ionian championship of the absolute sovereignty of the intellect in man-made truth was to teach the educated Greek the chasm between God and God's handiwork: be that handiwork stock or stone, bird or fish, animal or man. The tendency of the earlier philosophers was towards some form of pantheism. By degrees, however, philosophy progressed until it reached the heights of rational theism with Plato and with Aristotle. This progress was followed, as always happens in man-made progress, by a period of decadence: a relapse with the Stoics into pantheism; a relapse with the Epicureans into atheism. But, ever since philosophy had become a living power in educated Greece, critical minds there or elsewhere never went back to the vulgar polytheism of primitive paganism. Thus, Thales and those Ionians who created rational science had done an imperishable thing. A thing, too, which is, in the natural order, the most wonderful thing in the world. And a thing of which the world's history shows no other example.

It is undoubtedly true that the Eastern peoples in the age of Thales were considerably richer than the Greeks in accumulated facts. But these facts had never been observed for any scientific purpose, and had never suggested to the Egyptians or the Babylonians a revision of their superstitions. The Ionian mind had that in its fibre which was to carry it farther: the gift of an insatiable curiosity. "And it was just this great gift of curiosity, and the desire to see all the wonderful things—pyramids, inundations, and so forth—that were to be seen, which enabled the Ionians to pick up and turn to their own use such scraps of knowledge as they could come by among the barbarians. No sooner did an Ionian philosopher learn half-a-dozen geometrical propositions, and hear that the phenomena of the heavens recur in cycles than he set to work to look for law everywhere in nature, and, with an audacity almost amounting to ὕβρις, construct a system of the universe. We may smile at the medley of childish fancy and scientific insight which these efforts display, and sometimes we feel disposed to sympathise with the sages of the day who warned their more daring contemporaries to think the thoughts befitting man's estate. . . . But we shall do well to remember that even now it is just such hardy anticipations of experience that make scientific progress possible, and that nearly every one of these early inquirers made some permanent addition to positive knowledge, besides opening up new views of the world in every direction." (3)

"The Greeks achieved what they did, in the first place, because they were born observers. The anatomical accuracy of their sculpture in its best period proves that, though they never say

anything about it in their literature, apparently taking it for granted. The Egyptians, we may remember, never learnt to draw an eye in profile. But the Greeks did not rest content with mere observation; they went on to make experiments of a quite modern character. That by which Empedokles illustrated the flux and reflux of the blood between the heart and the surface of the body is the best known; for we have a description of it in his own words. It also established the corporeal nature of atmospheric air. We should certainly hear of many more such experiments if our sources were less meagre, and more intelligently compiled. Further, the Greeks always tried to give a rational explanation . . . of the appearances they observed. Their reasoning powers were exceptional, as we can see from the mathematical work they have left us. On the other hand, they were also quite conscious of the need for verification. This they expressed by saying that every hypothesis must save the appearances . . . ; in other words, that it must do justice to all the observed facts. That is the method of science, as we understand it still. It should be added that the development of mathematical and biological science at a given time to a large extent determines the character of its philosophy. We shall see how the mathematical influence culminates in Plato, and the biological in Aristotle." (4)

The Originality of Greek Rationalism.

The creation of rational science by a people so far from the East and at a date so late in the history of civilisation seems incredible. "We have, then, to face the question of the nature and extent of the influence exercised by what we call Eastern wisdom on the Greek mind. It is a common idea even now that the Greeks in some way derived their philosophy from Egypt and Babylon, and we must therefore try to understand as clearly as possible what such a statement really means. To begin with, we must observe that the question wears a very different aspect now that we know the great antiquity of the Ægean civilisation. Much that has been regarded as Oriental may just as well be native. As for later influences, we must insist that no writer of the period during which Greek philosophy flourished knows anything of its having come from the East. Herodotus would not have omitted to say so, had he heard of it; for it would have confirmed his own belief in the Egyptian origin of Greek religion and civilisation. Plato, who had great respect for the Egyptians on other grounds, classes them as a business-like rather than a philosophical people. Aristotle speaks only of the origin of mathematics in Egypt (a point to which we shall return), though if he had known of an Egyptian philosophy, it would have suited his argument better to mention that. It was not till later, when Egyptian priests and Alexandrian Jews began to vie with one another in discovering the sources of Greek philosophy in their

own past, that we have definite statements to the effect that it came from Phœnicia or Egypt. But the so-called Egyptian philosophy was only arrived at by a process of turning primitive myths into allegories. . . . But really it is not worth while to ask whether the communication of philosophical ideas was possible or not till some evidence has been produced that any of these peoples had a philosophy to communicate. No such evidence has yet been discovered, and, so far as we know, the Indians were the only ancient people besides the Greeks who ever had anything that deserves the name. No one now will suggest that Greek philosophy came from India, and indeed everything points to the conclusion that Indian philosophy arose under Greek influences. The chronology of Sanskrit literature is an extremely difficult subject; but so far as we can see, the great Indian systems are later in date than the Greek philosophies they most nearly resemble. Of course the mysticism of the Upanishads and of Buddhism was of native growth; but though these influenced philosophy in the strict sense profoundly, they were related to it only as Hesiod and the Orphics were related to Greek scientific thought.

"It would, however, be another thing to say that Greek philosophy originated quite independently of Oriental influences. The Greeks themselves believed their mathematical science to be of Egyptian origin, and they must have known something of Babylonian astronomy. . . . It thus becomes important for us to discover what the Egyptian mathematics meant. We shall see that, even here, the Greeks were original. The Rhind papyrus in the British museum gives us a glimpse of arithmetic and geometry as they were understood on the banks of the Nile. It is the work of one Aahmes and contains rules for calculations both of an arithmetical and geometrical character. . . . [The arithmetic] corresponds exactly, in fact, to the description of Egyptian arithmetic Plato gives us in the *Laws*, where he tells us that children learnt along with their letters to solve problems in the distribution of apples and wreaths to greater or smaller numbers of people, the pairing of boxers and wrestlers and so forth. This is clearly the origin of the art which the Greeks called λογιστική, and they probably borrowed that from Egypt where it was highly developed; but there is no trace of what the Greeks called ἀριθμητική, the scientific study of numbers. The geometry of the Rhind papyrus is of a similar kind, and Herodotus, who tells us that Egyptian geometry arose from the necessity of measuring the land afresh after the inundations, is clearly far nearer the mark than Aristotle who says it grew out of the leisure enjoyed by the priestly caste. The rules given for calculating areas are only exact when these are rectangular. . . . It is even assumed that a right-angled triangle can be equilateral. The rule for finding what is called the *seqt* of a pyramid is, however, on a rather higher level, as we should expect. . . . It seems an anachronism to speak of elementary trigonometry in connexion

with a rule like this, and there is nothing to suggest that the Egyptians went any further. That the Greeks learnt as much from them is highly probable, though we shall see also that, from the very first they generalised it so as to make it of use in measuring the distances of inaccessible objects, such as ships at sea. It was probably this generalisation that suggested the idea of a science of geometry, which was really the creation of the Pythagoreans, and we can see how far the Greeks soon surpassed their teachers from a remark attributed to Demokritos. . . . There is no real evidence that Thales had any mathematical knowledge which went beyond the Rhind papyrus, and we must conclude that mathematics in the strict sense arose in Greece after his time. It is significant in this connexion that all mathematical terms are purely Greek in origin.

"The other source from which the Ionians were supposed to have derived their science is Babylonian astronomy. It is certain, of course, that the Babylonians had observed the heavens from an early date. They had planned out the fixed stars, and especially those of the zodiac, in constellations. . . . They had distinguished and named the planets and noted their apparent movements. They were well aware of their stations and retrograde movements and they were familiar with the solstices and equinoxes. They had also noted the occurrence of eclipses with a view to predicting their return for purposes of divination. But we must not exaggerate the antiquity or accuracy of these observations. It was long before the Babylonians had a satisfactory calendar and they kept the year right only by intercalating a thirteenth month when it seemed desirable. That made a trustworthy chronology impossible, and therefore there were not and could not be any data available for astronomical purposes before the so-called era of Nabonasser (747 B.C.). The oldest astronomical document of a really scientific character which had come to light up to 1907 is dated 523 B.C. . . . when Pythagoras had already founded his school at Kroton. Moreover, the golden age of Babylonian observational astronomy is now assigned to the period after Alexander the Great, when Babylon was a Hellenistic city. Even then . . . there is no evidence that Babylonian astronomy had passed beyond the empirical stage.

". . . Thales probably knew the cycle by means of which the Babylonians tried to predict eclipses ; but it would be a mistake to suppose that the pioneers of Greek science had any detailed knowledge of Babylonian observations. The Babylonian names of the planets do not occur earlier than the writings of Plato's old age. . . . But even if the Ionians had known them (i.e. the Babylonian observations) their originality would remain. The Babylonians recorded celestial phenomena for astrological purposes, not from any scientific interest. There is no evidence that they attempted to account for what they saw in any but the crudest way. The Greeks, on the other hand, made at least three discoveries of capital importance in the course of two or

three generations. In the first place, they discovered that the earth is a sphere and does not rest on anything. In the second place, they discovered the true theory of lunar and solar eclipses; and, in close connexion with that, they came to see, in the third place, that the earth is not the centre of our system, but revolves round the centre like the planets. Not much later, certain Greeks took, at least tentatively, the final step of identifying the centre round which the earth and planets revolve with the sun. These discoveries . . . are only mentioned here to show the gulf between Greek astronomy and everything that had preceded it. On the other hand, the Greeks rejected astrology, and it was not till the third century B.C. that it was introduced among them.

"We may sum up all this by saying that the Greeks did not borrow either their philosophy or their science from the East. They did, however, get from Egypt certain rules of mensuration which, when generalised, gave birth to geometry; while from Babylon they learnt that the phenomena of the heavens recur in cycles. This piece of knowledge doubtless had a great deal to do with the rise of science; for to the Greek it suggested further questions such as no Babylonian ever dreamt of." (5)

The Religion of Rationalism.

"But while philosophy is thus intimately bound up with positive science it is not to be identified with it. It is true that in early times the distinction between the two is not realised. The word σοφία covered all we mean by science and a great deal more besides, such as the arts of making pontoons and guessing riddles. But the distinction was there all the same. If we look at Greek philosophy as a whole, we shall see that it is dominated from beginning to end by the problem of reality. . . . In the last resort the question is always, 'What is real?' Thales asked it no less than Plato or Aristotle; and, no matter what the answer given may be, where that question is asked, there we have philosophy. It is no part of a historian's task to decide whether it is a question that can be answered, but there is one comment he may fairly make. It is that the rise and progress of the special sciences depended, so far as we can see, on its being asked. We find that every serious attempt to grapple with the ultimate problem of reality brings with it a great advance in positive science, and that this has always ceased to flourish when interest in that problem was weak. That happened more than once in the history of Greek philosophy, when the subordinate problems of knowledge and conduct came to occupy the first place, though at the same time it was just the raising of these problems that did most to transform the problem of reality itself.

"And this helps to explain why philosophy cannot be simply identified with science. The problem of reality, in fact, involves the problem of man's relation to it, which at once takes us beyond pure science. We have to ask whether the mind of man can have

any contact with reality at all, and if it can, what difference this will make to his life. To any one who has tried to live in sympathy with the Greek philosophers, the suggestion that they were 'intellectualists' must seem ludicrous. On the contrary, Greek philosophy is based on the faith that reality is divine, and that the one thing needful is for the soul, which is akin to the divine, to enter into communion with it. It was in truth an effort to satisfy what we call the religious instinct. Ancient religion was a somewhat external thing, and made little appeal to this except in the 'mysteries,' and even the mysteries were apt to become external and were peculiarly liable to corruption. . . . Again and again (Greek) philosophy sought to do for men what the mysteries could only do in part, and . . . it includes most of what we should now call religion.

"Nor was this religion a quietist or purely contemplative one, at least in its best days. The mysteries had undertaken to regulate men's lives, and philosophy had to do the same. Almost from the beginning it was regarded as a life. It was no self-centred pursuit of personal holiness either. The man who believed he had seen the vision of reality felt bound to communicate it, sometimes to a circle of disciples, sometimes to the whole human race. The missionary spirit was strong from the first. The philosophers believed that it was only through the knowledge of reality that men could learn their own place in the world, and so fit themselves to be fellow-workers with God, and believing this he could not rest till he had spread the knowledge of it to others. The death of Sokrates was that of a martyr, and 'intellectualism,' if there be such a thing, can have no martyrs." (6)

Rationalism in Revealed Religion.

St. Augustine, St. Thomas, Scotus and Suarez would have endorsed every line of this pæan to the rationalists of Greece: St. Augustine because of the theism of the divine Plato; St. Thomas, Scotus, Suarez because of the rational theism of *the* Philosopher. These master-builders of Catholic Philosophy and Catholic Theology held that there never were more wonderful years in the history of pagan thought than these in which the brains of Plato and of Aristotle were ceaselessly working. They held, also, that it was no exaggeration to say there were no pagans to whom Catholicism owed a greater debt for the soundness of its philosophy of theism than to these two Greeks. And under the guidance of one or other of these amazingly powerful and subtle minds, the four master-minds of Catholic Apologetics insisted on a twofold usage of rationalism in Revealed Religion: one for the conversion of the unbeliever; the other for the protection of the believer.

The first and nobler usage of rationalism is to prepare the adult unbeliever for faith by rational proof of the motives of credibility.(7) It is only the rational study of philosophy which

can convince atheist or agnostic or pantheist of the existence of an infinite, knowable, personal God. It is only the rational study of history which can convince infidel or heretic that the Gospels and other writings of the New Testament are authentic documents proving beyond all reasonable doubt that Christ was God ; that He established a visible society, one and imperishable ; that He appointed a perennial authority which is infallible in its religious teaching and supreme in its religious control ; and that the Catholic Church is that society. These are the ordinary processes of enquiry that lead an unbeliever to the faith. Sometimes there are conversions like those of Saul on the way to Damascus. But, apart from these exceptional cases, conversion is a work of reason, abetted by prayer, originated and sustained by supernatural grace. There are, of course, minds and minds. The psychology of conviction concerning the motives of credibility is as bewildering as the psychology of conviction concerning other personal human opinions. The highways and byways of human conviction are multifarious and tortuous. The way of objective truth is straight and narrow. Now the strong point of the attitude of the Catholic Church towards rationalism is her insistence that the motives of credibility are objectively true and will stand the most exigent rational tests in history and in philosophy. St. Augustine and St. Thomas, Scotus and Suarez taught that reason can demonstrate the existence of God and that history can prove beyond doubt the divine institution of an indefectible, infallible Church. And in later ages when Hume's assault on miracles and Kant's assault on rational theology shook the nerve of many famous apologists, the Church began by disavowing this failure of nerve and ended by setting her seal on the teaching of Fathers and Schoolmen about the necessity of rationalism in religion. De Bonald, Lamennais, Bautain, Ventura, Bonetty, Ubaghs appealed during the nineteenth century from rational philosophy and rational history to Tradition ; each of them in turn denying under one formula or another the possibility of rational proof of the motives of credibility. But the Church would have none of all this. Gregory XVI and Pius IX repudiated all these attempts to rob theology of its philosophical and historical bases. And at the Vatican Council, the Church made that item in Traditionalism which appeals most to the unwary the subject of her heaviest censure. " If any man says that God, one and true, our Creator and Lord, cannot be known by the natural light of human reason through the things that are made, let him be anathema." (8)

" This, then, is one office of Reason, to help in leading men to the faith who had it not before. But also for the faithful themselves as such, Reason is of the highest value. It relieves the pressure and strain upon faith, when it is attacked by argument from without or by the mind's own questionings from within. Faith, as we have shown,(9) is equal to the strain. The result of adverse argument is not any doubt of matter of faith, but still

it is a temptation, and temptation is always painful to those who love good. It is painful as an accusation against a mother whom one tenderly loves and has learned thoroughly to trust. The accusation is not entertained in the mind for a moment as a thing that could possibly be true, but perhaps it cannot be disproved, and then it pains us. When a good friend rises up, and by argument scatters the charge to the winds, we owe him gratitude for a very sensible relief. So we are pleased when the orthodoxy, if not the personal character, of certain Popes is vindicated by historical argument. We knew and held firmly by faith that our Lord would never permit His Vicar to teach heresy from the chair of truth. . . . Still the confident assurance of this eminent anti-Catholic historian loomed upon us as an ugly bogey, till one day we read with relief how an historian of equal eminence and learning had been able to write against all his allegations, *non-proven*. . . . The function of reason (in this second usage) is rather negative, to show the inclusiveness of objections, than positively to prove a dogma or a fact of faith. Much of the matter of faith is beyond the reach of direct proof. But when a disputant fresh from the Schools swoops down on us with an argument, as he says, for the impossibility of transubstantiation, and we find that he has got hold of the Lockian definition of substance, as the sum of the sensible qualities of the object, we congratulate him on the logical sequence of conclusion from premises, but send him back to learn a better definition of substance." (10)

Apart from all this theoretical evidence of the estimate set on rationalism in religion by the Church, her methods of intellectual training gave a practical estimate of her belief in the importance and value of reason to Faith. "If a man of scant leisure spends his time, and a man of limited means spends his money, lavishly upon a certain pursuit, this is the clearest evidence that he sets store by that pursuit. The Catholic Church generally is not rich, and she wants ministers for service early in their lives. Yet, under the name of Philosophy, Theology, or Divinity studies she insists on putting men through a severe course of close reasoning on things of faith, leading up to faith, or consequent upon faith, and that for three, four or six years, ere she will ordain them. And experience proves her right. One of the greatest blows that the Church received in the French Revolution, as great a blow almost as she ever could receive, was the closing of her ecclesiastical Seminaries wherever the Revolution or the wars of the Revolution spread. It was the policy of Julian the Apostate reiterated ; for Julian would have cut off the Christians from all culture and exercise of mind. That temporary paralysis of philosophy and theology had its effect in enfeebling the teaching ability of the Church's ministers far into the present (nineteenth) century.

"*Credo quia impossible* was Tertullian's paradox, but the Church has never endorsed it. Tertullian was a headstrong

violent man, whose untamed impetuosity finally carried him out of the Church into the Montanist heresy. . . . The Church has nothing to gain from prejudice, confusion of thought, ignorance, mental darkness, surface habits of mind, and lazy reluctance to investigate and face spiritual realities. No cause in the world suffers so much as her cause from these human miseries. Though faith is the very breath of her nostrils, yet she cries for reason also; the cry of St. Augustine, *Ama valde intellectum*—Love understanding exceedingly." (11)

"This train of thought brings us within sight of some hope of removing from (the philosophy of) Scholasticism a reproach which more than any other cause has prejudiced the modern mind against it, and is the greatest obstacle to its propagation. I mean the reproach of being pledged to foregone conclusions, of being tethered to orthodoxy like a captive balloon to the earth. This reproach grows greater with the lapse of time, as the attaching ropes are multiplied and made stronger by new condemnations of error and new definitions of faith. The reproach may be removed by this reflection, that definitions of faith fall upon judgments, not upon reasonings; not upon speculations but upon assents. It is a rule of the Higher Philosophy to speculate freely, but to assent cautiously, to think much but believe little. Faith challenges our belief, not our logic: it does not say, *this is proved*, but *this is*. You may call Scholasticism or any orthodox philosophy a captive balloon; but for tentative ascents, for exploration and reconnoitring purposes, the ropes that hold it stretch to infinity. You may see and meditate all that can be said for any condemned doctrine, provided you do not hold the doctrine itself. You may sound all the depths of Hegelianism and see with your mind's eye all the gloomy visions of Schopenhauer, provided you hold fast to the Nicene Creed and Vatican Council, and do not deny, however little in some respects you may be able to justify, the Providence of God. Nor is it quite exact to say that the dogmas of faith are foregone conclusions. They are foregone truths. They are not presented to our belief as conclusions. We may never be able to reach them by way of conclusions. Some are confessedly inaccessible to conclusive argument, as the doctrine of the Triune God. Some may be accessible, but I cannot find the way. There is a way up the Matterhorn, others have gone to the top, I start and fail. I have to take the feasibility of the ascent on the word of others. So with such a doctrine as the immortality of the soul. I have not the least doubt that the soul is immortal: my faith tells me so. But I am as free as any other man in judging of the value of the arguments for immortality. I may search them all and condemn them all; and, with Scotus, I may have to fall back upon my faith as the one sure guarantee of my immortality. A truth of faith can never be in question; but my ability to vindicate a given truth of faith is a very open question indeed. I am satisfied with the word of God; but my own philosophical or critical and

historical speculations may fail to satisfy me, at least for the present. Perhaps I may reason better to-morrow: meanwhile I will believe, even to-day.

"A Catholic will say: this free philosophical speculation, trying all conclusions, but holding aloof from assents, where the word of the Church forbids them, is a dangerous game. It is dangerous. Alpine climbing is dangerous, and fox-hunting. All the stronger efforts of man's body and mind are fraught with danger, not excluding the paths of higher sanctity. There is danger of broken limbs, of lunacy, of intellectual pride and apostasy. If Scholasticism is to revive—and Popes have bidden it live again—the Neo-Scholastic who shall lead the movement of revival will need to be a man of great faith, fearless speculation, and absolute reliance on the word of God. . . . 'What makes against the faith, either as a consideration in the mind of the believer, or in the way of exterior persecution, augments the merit of faith, so far forth as it reveals a will more prompt and firm in the faith. Therefore also the martyrs had greater merit in faith, not receding from the faith for persecution, and likewise men of learning have greater merit of faith, not receding from the faith for the reasons of philosophers or heretics alleged against it.'—(St. Thomas, *Summa Theologiæ*, 2a-2ae, q. 2, art. 10)." (12)

ARISTOTLE'S DIVISION OF SPECULATIVE PHILOSOPHY OR SCIENCE.

Aristotle (13) seems to distinguish all sciences into Speculative and Practical: Speculative Philosophy comprises all the speculative sciences; Practical Philosophy comprises all the practical sciences. This distinction arises from differences in purpose, in subject-matter and in exactness: the purpose of a speculative science is to know, that of a practical science to do; the subject-matter of a speculative science is some form of reality which "can by no possibility be otherwise," that of a practical science is some form of reality which "can possibly be otherwise"; the conclusions of a speculative science are rigidly universal truths, those of a practical science are simply general rules which hold good in the majority of cases.

There are three branches of Speculative Philosophy or Science: First Philosophy, Mathematics and Physics. Each of these has its own special topic for investigation and its own special first principles. First Philosophy (also called by Aristotle Wisdom or Theology, and, later, called by his disciples Metaphysics) investigates being as being and the connexions which arise between various beings simply from the fact that all of them are in some sense real: hence every kind of being as real and every fundamental principle of being as real come under its scope. Thus First Philosophy investigates what can be meant by saying that anything is real: it distinguishes the various doses of reality that are found in all these real beings; it analyses being into substance and accident, potency and actuality, and into its four causes;

and as the explanation of these four causes is impossible apart from a motionless Prime Mover, the First Philosophy becomes towards the close a rational theology of God. Mathematics and Physics are distinguished from First Philosophy by the fact that both of them deal with only certain classes of beings: they are, then, "Second Philosophies." Mathematics deals with objects that are motionless and immutable and yet are attributes of material bodies: points, lines, surfaces, numbers—the ideal limits or numerical properties of concrete things. Physics deals with the motions or changes of sensible bodies. Thus First Philosophy studies being as real, Mathematics studies being not as real but as measurable and numerable, Physics studies being not as real nor as measurable and numerable but as corporally changeable. Finally, the special first principles of each speculative science vary with its scope. First Philosophy has the least complicated set of first principles because it has the widest range of objects. Mathematics has a more complex set of axioms than First Philosophy: it needs not only the first principles that are valid for being as being but also those first principles that are valid and significant in the realms of numbers and figures. Physics requires the most complex set of principles of all three: its subject of investigation is change in bodies and bodies that are changeable are also real, measurable, numerable.

The Physics of Aristotle.

The branch of Aristotelian science or philosophy of most interest to the cosmologist is the Physics. That Physics is intelligible only from Aristotle's view of science and scientific proof. The aim of demonstrative science or philosophy is, according to the Stagyrite, truth. Truth is the undistorted mirroring by consciousness of reality. Now Aristotle held that every existing individual was what it was by reason of its essence or inner ground. Hence we can have scientific knowledge of an existing individual only when we are able to trace the connexion of the contents of that individual with its essence. The scientist or philosopher attains truth when he analyses and resynthesises an individual in such a way as to make clear the inner necessity that links the sensible accidents of that individual with its essence. He is started on this quest by observing facts of experience. These facts, inasmuch as they are merely known to happen, belong to the world of opinion not to the world of science. But their happening suggests to the scientist or philosopher a problem: the problem of demonstrating a necessary connexion between the observed fact and the essence. The solution of this kind of problem involves both induction and deduction: induction for the purpose of discovering essences and first principles; deduction for the purpose of converting a mere conjunction of fact into a rational connexion. Should our scientist or philosopher succeed in demonstrating this rational connexion, his conclusion is scien-

tific or philosophic ; he knows not merely that the fact happens but also why it must happen. An illustration from the science or philosophy of Mathematics will make the meaning of all this clearer. The man who convinces himself by measurement that the sum of the angles of a plane triangle is equal to two right angles has not a scientific or philosophical knowledge of that proposition. Such a man attains scientific or philosophical knowledge only when he sees that this proposition follows from the definition of a plane triangle by repeated application of the principles of geometry. That is why Aristotle insists that it is the aim of science or philosophy to find out the middle term—one or more—which will convert facts of experience into demonstrated conclusions. That is why he represents the scientist or philosopher as filling up the interval between a mere fact and the definition of an essence by packing that interval with a middle or middles as mediated necessary connexions. That is why science or philosophy in reference to any class of individuals presents itself, to Aristotle's mind, as a syllogism or series of syllogisms in which the reason for all that is scientifically or philosophically known concerning this class of substances is shown to be the specific essence of the class.

This view of science and of scientific method is the basis of Aristotle's Physics.(14) The subject-matter of Physics is change or motion in natural bodies : and a natural body is, for Aristotle, any body that contains within itself an originative source of motion and rest or an impulse to change. Hence his Physics is scattered over several treatises : *Physica, De Cœlo, De Generatione et Corruptione, Meteorologica, De Anima, Parva Naturalia, Historia Animalium, De Partibus Animalium, De Motu Animalium, De Generatione Animalium.* His Physics is, then, the science or philosophy of all changes in bodies whether lifeless or living. But these bodies exist only as singular individuals endowed with an inexhaustible wealth of perceptible attributes. Science or philosophy deals, however, only with an orderly sphere of necessary connexions between essences and properties. Therefore, the duty of the Aristotelian Physicist is to select from the far richer but only partly intelligible world of sensibly perceived bodies the essences, the properties, and their reciprocal linkages. He starts by reminding us that every science takes for granted certain things on one or other of two grounds : some things are taken for granted because they are so evident as to need no proof ; other things are taken for granted because they are proved independently elsewhere. Physics takes for granted the existence and meaning of natural bodies : it takes for granted the division of natural bodies into various genera and into ultimate species ; it takes for granted—as a second philosophy—the principles and conclusions of First Philosophy. Then, it gets from observation the clue to the existence of its own special problems. Next, it discovers, by induction, the various definitions of essences and the first principles that refer to natural bodies. Finally, it

demonstrates, by deduction, that there are sensible accidents in natural bodies which belong to these bodies as a necessary consequence of their specific essence: accidents that are found to qualify every member of a distinct species and that, strictly-speaking, qualify no member of another species; accidents that are known, in Aristotle's technical terminology, as properties.

Had Aristotle in the Physics achieved the kind of knowledge at which he was aiming and had he succeeded in expressing it in what he would style the ideally appropriate way, that science would appear in his text as an ordered system of apodeictic syllogisms. "In these syllogisms every term will be universal; and *in the basal syllogisms*, on which the system depends, every premiss will be an immediate commensurate judgment, reflecting an immediate reciprocally-necessary *nexus* between substance and *proprium* or substance and constitutive moment, or proximate cause and proximate effect. The conclusion of every syllogism will include the middle term and will be a mediate commensurate judgment, reflecting a reciprocally-necessary nexus between substance and *proprium* mediated through the proximate cause of the inherence of the latter in the former. The three terms of every such apodeictic syllogism can be rearranged and concentrated so as to constitute the adequate scientific definition of the *proprium* in question. . . . None of Aristotle's examples completely fulfils the conditions of a perfect apodeictic syllogism, adapted to form the basis of a system of scientific demonstrations." (15) What is worse, his view concerning what we may call the empirical, as distinct from the metaphysical, science of matter and its attributes turned out to be hopelessly fantastic. Still, the student who does not realise Aristotle's aim in this domain and also the methods by which he sought to achieve that aim, can never hope to get a grip of the perennial value, despite multitudinous errors and puerilities, of Aristotelian Physics.

The Revolt against Aristotelianism.

From the middle of the sixteenth century onwards, the new wine of modern science and modern philosophy burst these old Aristotelian bottles—Physics, Mathematics, Metaphysics. Most of the pioneers in modern physics and modern mechanics were rigorous experimentalists: men who made the exact measurement of quantities and the careful testing of hypotheses the keystone of science. Their immediate and astonishing success destroyed the prestige of Aristotle's view of science and of scientific proof; the scrupulous observation of facts and the experimental verification of the laws of nature ousted everywhere the Aristotelian preference for genera and species and for deductive argument from essences to properties. One of the necessary consequences of this new outlook in science was a new classification of those branches of learning which the Greeks had bundled together under the synonyms, Science or Philosophy.

In every branch of knowledge, empirical science became divorced from metaphysical science: each was cultivated by different men and along different lines. Thus topic after topic of the Aristotelian Encyclopædia—hitherto the preserve of medieval theologians and philosophers—was taken over and made the object of one or other of the ever-growing branches of modern science: moreover, these topics were treated after a fashion wholly unknown to Aristotle and the School, and in many instances blossomed out into sciences that horrified the upholders of traditional learning. And while this was happening in natural science, modern philosophy was launching system after system in opposition to the philosophy of Aristotle and the School. Our only concern, however, is with the fate of those portions of the Physics that embody the science and philosophy of matter. It was against that part of the Aristotelian line that the modern world flung its shock troops. And as I shall record hereafter, (16) that part failed hopelessly to withstand their attack. The first result of this successful revolt against Aristotelian Cosmology was the identification from an opposite point of view of the science and philosophy of matter: Aristotle identified the science of matter with the philosophy of matter because he held no conclusion to be scientific that was not syllogistically demonstrated; these early modern anti-Aristotelians identified the philosophy of matter with the science of matter because they held no truth was discoverable about matter other than the facts and laws and theories of empirical science. A baptised and experimentally enlarged edition of Greek atomism thus became rehabilitated in Europe as the last word of science and of philosophy on matter and its properties. Descartes was too keen a mind to share this naïve outlook, but he was unwilling to disillusion the many: apparently, his desire to curry favour for his kineticism was stronger than his sense of candour.(17) Leibniz fastened on this chink in the armour of Descartes and made the unmasking of the popular delusion a central aim of his life's work as cosmologist. The talents of Descartes and of Leibniz as mathematicians and as physicists made it impossible for students of the new physical sciences to ignore this little rift in the lute; the controversies between them on the principles of Mechanics agitated every university and every learned academy in Europe. The result was that even experimentalists began to realise there may be two views of matter and its properties: the view of the physicist and the view of the metaphysician. That stage of mental development ushered in the period of human thought which acknowledged a complete divorce between the science of matter and the philosophy of matter; at least in the sense, that henceforth any thinker who was aware of the actual state of this problem felt bound to give his reasons for denying the existence of a philosophy of matter as distinct from a science of matter. Thereupon, a fresh division of the branches of philosophy was adopted outside the Aristotelian school. Logic, formal and real, continued to be

for these anti-Aristotelians, as it had been for Aristotle, a propædeutic to philosophy : it is impossible to argue consistently in philosophy or elsewhere unless one obeys the rules of Formal Logic ; moreover, the kind of systematic thinking that one aims at in philosophy or elsewhere depends on the conclusions reached about the scope or value of human knowledge in Real Logic (*alias* Criteriology, Epistemology). All speculative philosophy came to be called Metaphysics. This modern Metaphysics is subdivided in General and Special. General Metaphysics, which is also called Ontology, studies being as such and the attributes of being as such. Special Metaphysics is the application of the principles of General Metaphysics to the three great classes of beings : Nature, Soul, God. Rational Cosmology is the title of the special metaphysics of Nature. Rational Psychology is the title of the special metaphysics of Soul. Rational Theology is the title of the special metaphysics of God.

This modern division was later still accepted by the Aristotelian School. Its adoption is largely a question of practical convenience, for, it is obviously of little importance what titles you give to the subdivisions of any branch of knowledge or how you distribute its problems amongst these subdivisions, provided you take care that all the problems are treated somewhere or other. There is, however, a slight difference of opinion among contemporary scholastics as to the scope of Cosmology. Some scholastics make Cosmology the philosophy of Nature and treat therein not merely of inanimate but of living bodies : a usage that has the advantage of being upheld by modern non-scholastic schools. Other scholastics make Cosmology the philosophy of matter and treat therein only of inanimate bodies : leaving the study of all sorts of living beings to Rational Psychology for the reason that plants and animals have souls of a sort. In this book, I adopt the second usage for the purely personal reason that the discussion of the philosophy of matter apart from the philosophy of life has taken on, in the course of my inquiry, a wholly unforeseen length.

Physical Science and Modern Philosophy.

Descartes is rightly acclaimed the pioneer of the explanatory ideal which has in recent centuries dominated Physical Science in its attempt to explain matter and the qualities of matter. To him it is due that modern theoretical physics denies the existence in matter of everything which Aristotle and the School regarded as quality : the primary qualities of modern science or modern philosophy were, for Aristotle and the School, not qualities but quantities. To him is it due that modern theoretical physics attempts to solve the problem of non-living bodies by matter and motion. For all that, his physical investigations were infected by the same methodical error as were those of Aristotle : a minimum of experience sufficed for a maximum of inference. He started from clear and distinct ideas. And having satisfied

himself rather hastily that extension is the only attribute which the mind cannot abstract from bodies he concluded that extension was the essence of matter. Now, Geometry deals with the laws of extension as embodied in geometrical figures. Again, Arithmetic and Mechanics deal with the laws of the measurement of extension and of motion. Hence Descartes concluded that by the study of these sciences man can unlock the secrets of matter and explain the composition, the properties, and the mutual relations of lifeless bodies. This method of scientific inquiry was obviously as *a priori* as the method used by Aristotle.[18] And the only reason why it led Descartes to conclusions apparently more conformable to the results of all subsequent theoretical physics was, that extended particles and motion formed his initial data. But the history of modern science proves that physics could have made no genuine progress, had not the *a priori* methods of Cartesian physics been contemptuously set aside by the experimental pioneers: Galileo, Huygens, and Newton. These pioneers agreed with Descartes in denying the extra-mental reality of the proper sensibles; that is, they explained away these proper sensibles as subjective illusions due to the action on our sense-organs of purely quantitative particles. But while they and their successors refused to admit any material forces save those which cause local motion, they never reached a unanimous view on the nature of these motive forces; one group held that some of these forces were inherent active powers in matter; another group held that all these forces were really invisible motions of invisible particles. For a long time, however, all physicists continued to speak of the particles of matter as substances and of the forces (real or fictitious) of matter as causes. But the older metaphysical interpretation of substance as self-subsisting being and of cause as active being became, by degrees, less and less attractive to the students of a science that boasted of being concerned with the real facts of nature and of scorning with all its might the hobgoblins of metaphysics.

Fate was kind to these troubled physicists. Modern philosophy stepped in to rid them, apparently for ever, of the only traces of metaphysics embedded in the Cartesian ideal of physics. Hume set out to prove that the notion of substance as self-subsisting reality was but an irrational instinct—something akin to the social convention which insists that we may not use cups without saucers: that the notion of cause as activity was another irrational instinct of preceding ages—something akin to the rustic's terror at the play that the villain is going to murder the hero. The metaphysicians were naturally furious with Hume. But, by one of these ironies of history that occur in every department of life, the pro-metaphysical champion that caught the attention of the public was Kant. It took the metaphysicians and the physicists a long while to disentangle from Kant's cumbrous and obscure terminology the gist of what he himself styled mental Copernicanism. But when the physicists did learn what

Kant was driving at, they realised that they need not trouble further in physics with the bugbears of substance and causality. Kant had taught unmistakably that substance and cause—and indeed every other fundamental concept in systematic thought—were simply dress-suits made by man's mind for extra-mental realities in order that these ragged and unruly urchins of the outer darkness might be transformed into well-groomed and orderly members of the world of science. Hume and Kant took the world of their day by storm. Physicists would be less than human did they not avail themselves of this turn of events in philosophy to fling to the wind all further scruples about the traditional meanings of substance and cause. Thereupon, what is sometimes called the positive age of science was ushered in: scientists profess to mean by substance simply a sensibly-perceived or perceptible fact or a group of such facts; scientists profess to mean by cause simply the invariable succession of sensibly-perceived or perceptible facts. Hegel attempted to stem the rising tide of radical empiricism in science and in philosophy by the metaphysics of Objective Idealism. He was successful in exhibiting the flimsy basis of Humian scepticism and of Kantian agnosticism. But his constructive ideals were lost on the physicists owing to a popular belief that he was trying to replace the experimental investigation of matter by the ancient and totally discredited methods of metaphysical deduction.

Physicists and mathematicians are, of course, perfectly justified in ridding their own sciences of any metaphysical ideas which they find useless or worse in these branches of learning. They are not justified on that account in treating these ideas as wholly illusory in reference to the world of facts. This question is at least further arguable. To treat it as closed, simply because of the advantage occurring to physics and mathematics from the exclusion of such ideas, is to adopt the outlook of the student of shorthand who imagines phonetic spelling ought to satisfy the purposes of orthography.

The Evolution of Modern Physics.

Prior to the advent of Planck and Einstein, the progress of physical science had centred about five leading theories: the theory of attractive and repulsive forces, atomism, kineticism, the laws of energy, and the theory of electrons.

Newton (1689) gave the first progressive impulse to modern physics by abstracting from the mechanics of Galileo and Huygens and the astronomy of Copernicus and Kepler the formula of universal gravitation. A hundred years later, the continental development of Newtonianism found its most complete and confident expression in the system of Laplace: a system in which atoms with attractive and repulsive forces were offered as the ultimate explanation in astronomy, physics, and chemistry

of all interaction both between molar and molecular bodies. And so satisfying was this system to a certain type of continental physicist that, despite the popularity elsewhere of kineticism, this view prevailed there till the close of the nineteenth century.(19)

The atomic theory of Dalton (1803) introduced into chemistry a consistent exposition of the laws of fixed and multiple proportions, and this became the fulcrum of all subsequent advances in that science. But Dalton's theory had to undergo, especially in the first half of the nineteenth century, so many changes for the purpose of adapting itself to newly discovered facts that many eminent chemists of the time looked on chemical formulæ as nothing more than a convenient symbolism. It was only when the kinetic theory of gases was domiciled in Physics by Clausius and Maxwell about the middle of that century that these doubts of the chemists were definitely set aside and replaced by a belief in the physical reality of atoms. Thereupon, structural chemistry and stereo-chemistry began their popular career: chemists, no longer content with a knowledge of the relative weights of atoms, attempted to discover the geometrical arrangements of atoms in the compound. And this ambition fixed their attention on the most difficult problem of all: chemical affinity.

While these problems were being tackled in chemistry, a big revolution had been wrought in Physics by a return to the unpopular ideals of Cartesian kineticism: unpopular, I say, because despite the triumphal progress of continental Newtonianism, kineticism had ever had its admirers—among them Huygens, Euler, Rumford, Young. The nineteenth-century herald of kineticism was Fresnel, the Newton of Optics. He made kineticism popular by his undulatory theory of light and by reminding his contemporaries of the value of kineticism in Acoustics. These kinetic successes in Acoustics and in Optics led to a renewed belief in the Cartesian ideal of a thoroughly kinetic interpretation of every physical property of matter: of heat, of electricity, of magnetism, and even of gravitation. This belief received a great impetus through three independent branches of research of a purely theoretical nature: the researches of Joule, Clausius, and Maxwell on the kinetic theory of gases, the researches of Helmholtz and Kelvin on vortex motions and vortex atoms; the researches of Faraday and Maxwell on electricity and magnetism. This wave of kineticism involved enthusiastic discussions first about the existence of ether, then about its nature, and then again about its existence: discussions whose unsatisfactory result has since been emphasised by the uselessness of this entity in Einstein's scheme. Nor was this problem about the nature of ether the only thorn in the side of the kineticists: gases never became thoroughly kinetic; Kelvin acknowledged publicly the failure of the vortex atom; in electro-magnetism, Maxwell abandoned physical and real models for illustrative and symbolic ones.

The kinetic revival was affected towards the middle of the nineteenth century by a discovery of more general application than either gravitation or atomism or kineticism: that of a real quantity called Energy—the power to do mechanical work. Mohr, Mayer, Joule, Clausius, Kelvin and Helmholtz discovered and developed the laws of the conservation and degradation of Energy. These laws revolutionised the theoretical side of physical science: a new vocabulary had to be created; the old text books had to be rewritten; well-known and approved theories had to be revised and restated; new and promising fields of research such as physical chemistry became possible. But the most piquant result of all was the emergence of a scientific heresy under the name of Energetics. These Energists were a band of scientists who condemned all atomic and ethereal hypotheses as useless and mischievous chimeræ of the scientific imagination: indeed, some of them went the length of condemning matter itself as a chimera, and of seeking to prove by balance and calculi the existence of nothing but Energy. The attitude towards these scientific dissenters of the majority of the upholders of that branch of learning, which rarely lost an opportunity for centuries of ringing the changes on Galileo, must ever prove a delightful study for sardonic theologians: there is a lot of human nature even in scientists. Energetics, unless I be mistaken, has not made good: it was born out of due time. For just as the Energists were delivering their sledge-hammer blows on atoms and ethers, the discovery of the electron fixed the old idols more firmly than ever in men's minds. But the electron brought the atomic model of Rutherford and Bohr (1911-22) postulating that all of the positive and about half of the negative electricity of the atom is concentrated at the centre, forming a very small body called nucleus; postulating also that energy exists in little parcels, the quanta of Planck. Add to Rutherford and Bohr and Planck the relativity theories of Einstein and their unknown consequences in physics, and one realises why from the physicists themselves there has arisen at long last a cry for a thorough overhauling of the principles and methods and purposes of physics: in short, for an epistemology of Physics as an experimental and mathematical science.

Theoretical Physics and Abstract Mechanics.

Descartes thought to reduce all physics to a geometry of motions on the assumption of a created indestructible motion. But this was, as Leibniz pointed out, to forget that Mechanics is possible only on the condition that the positions of bodies are determined in their mutual dependence by a relation of force, a function of time. That is why modern Mechanics was able to enter on a fruitful development only when the Cartesian view was replaced by the views of Galileo, Huygens and Newton. Now this fruitful outlook in Mechanics was permeated from the

start by two rival methods which have never since been able to come to terms: some theoretical physicists have been content, as occasion arose, to make use of both methods without facing the question of the superiority of one to the other; other theoretical physicists have sought vigorously century after century for the supremacy of one or other of these two methods. These rival methods are known as the Galileo-Huygenian and the Galileo-Newtonian. The Galileo-Huygenian operates almost exclusively with the notions of work, mass and *vis viva;* the Galileo-Newtonian operates almost exclusively with the notions of force, mass and momentum. The one method regards the momentum of a system of bodies as determined by forces; the other regards the *vis viva* of a system of bodies as determined by work. The individuality of each student determines largely his choice between these methods. That is why at the close of the nineteenth century, Helmholtz, in the preface to the posthumous work of his pupil Hertz, acknowledges the logical consistency of Hertz's plea for the Galileo-Huygenian system of mechanics, but declares his own preference for the Galileo-Newtonian system. But long before Helmholtz and Hertz had agreed to disagree on this point, two facts of importance for the future of theoretical physics had emerged: the peculiar psychological satisfaction aroused in men's minds by thinking of matter and motion as the ultimate explanation of the activities of non-living bodies; and the astonishing progress of the science of abstract mechanics.

These two facts secured for Descartes as mechanist a triumph even greater than his failure as physicist. The pioneers of modern physics had no sooner discovered, by observation and experiment, by hypothesis and verification, a number of laws of nature, than they naturally set about the theoretical explanation of these laws. Now, explanation must stop somewhere. And what is more satisfying or more simple than extended particles and local movements? Moreover, the success of abstract mechanics was based solely on the motion of mass-points: the Galileo-Huygenian mechanics admitted nothing else; and the force of the Galileo-Newtonian mechanics was really a mass-acceleration. Hence, the path seemed clear for explaining everything in the world of matter by mass and motion, and the task of reducing all physics and all chemistry to abstract mechanics became a dominant ideal in theoretical physics. It was always allowed—even prior to the emergence of contemporary electro-mechanics and of the quantum theory—that this reduction of Physics and Chemistry to Mechanics was not complete: still, there was no doubt about its being a thoroughly sound ideal whose value was continually enforced by the assimilation of old facts and the discovery of new facts. The advent of electro-mechanics and of the quantum theory has made this dominant ideal more difficult. But hope springs eternal in the human breast: and although at the moment these divergences in Mechanics are threatening to become, if anything, rather more than less fundamental and mysterious, the leaders

all look forward to a stage of scientific thought when classical mechanics and electro-mechanics and the quantum theory shall be expounded as consistent parts of a homogeneous whole.

The Practical Interest of Physical Science.

"There always have been, and always will be, several (non-scientific) interests which induce men to study nature. Some are driven to it by curiosity or a pure love of nature. To those who belong to this class the end of the study of nature is to describe and to portray the objects which surround us, to see and know them better. . . . This is the genuine love of nature, the consciousness that we lose all power if, to any great extent, we sever or weaken that connexion which ties us to the world as it is—to things real and natural: it finds its expression in the ancient legend of the mighty giant who derived all his strength from his mother earth and collapsed if severed from her. In its extreme and purest form this interest probably lies at the root of all poetry and all art, and it accordingly governs a great part of the literature and thought of the (nineteenth) century. At present it interests us only as far as it asserts itself also in science. In the study of natural science we meet with a class of students who are attracted by things as they are: not so much by those which we artificially prepare in our laboratories, as by the infinite variety of real forms; not so much by the geometrical types which allow us to bring them together under some abstract formula, as by the apparent disorder and divine confusion in which real things are scattered about in the heavens and on our globe. It is not the general equation which in its complete solution contains all real and many unreal instances merely as special cases that interests them, but the individual examples themselves. . . .

"It would seem as if to such minds the scientific formula, the so-called law of nature, must be distasteful and probably useless. Nevertheless the scientific view, of which the mathematical formula is an extreme expression, has reacted, though not always beneficially, upon the labours of those who confine themselves to observation and description; it has given to their efforts general interest and encouragement, indicated new directions, and frequently opened new fields. Thus the new formula of Copernicus and Galileo gave a great impetus to star-gazing, which was greatly increased by the almost contemporary invention of the telescope. . . . It seems as if the purest love of nature, the greatest devotion of the observer and the collector, lead only a little way in finding out the hidden paths of natural things or the behaviour of natural objects; and however grateful we must be to those pioneers of knowledge who with unrewarded patience amass the material for later theorists, it is . . . to the formulæ of a Newton or a Gauss, followed by the calculations of their pupils, that we are indebted for a real grasp, for a comprehensive knowledge, of great masses of natural phenomena.

"Next to the pure love of nature, the desire to apply natural knowledge, and to make it useful for practical purposes, has rendered in return great services to science. The Royal Society and the Royal Institution had both from their infancy a large admixture of the practical spirit. These were founded, more even than the academies abroad, to a great extent upon the desire to make knowledge useful. . . . The Governments of England and of France promoted the study of the 'mechanics of the heavens' by offering large prizes for scientific and practical means of determining the longitude at sea. The lunar theory, which has occupied the attention of the greatest mathematicians since Newton . . . was an outcome of this. It still engages the attention of scientific minds, involving as it does all the most delicate astronomical calculations, whilst for practical nautical purposes the moon has ceased to be the great timekeeper and has, since 1763, been replaced by the wonderful chronometers of Harrison and his successors. A similar stimulus both to abstract scientific research and to the perfection of the practical instruments of measurement was given in this (nineteenth) century by the development of submarine telegraphy: in this case both sides of the problem, the scientific and the practical, were attacked and carried to a high degree of perfection by one and the same mind—an almost unique instance of abstract reasoning and practical inventiveness." [20] That mind was Kelvin's: he failed—and acknowledged failure—at a comprehensive theory of matter, but he succeeded in patenting more than seventy practical inventions. "How much science owes to the practical interests of navigation can be seen at a glance at the subjects contained in the third volume of Lord Kelvin's *Popular Lectures and Addresses*. The Tides, Deep-sea Sounding, Cable-Laying and Terrestrial Magnetism all furnish important practical as well as highly abstract theoretical problems, the solution of which demands new instruments and new methods of calculation . . . ." [21]

"There has always existed one great interest in which nearly all the descriptive branches of human knowledge have found a common rallying ground and a uniting purpose—namely, the art of healing, the alleviation of human suffering and the curing of disease. During long ages, when the purely scientific interest was almost dead, physical and chemical research was created and kept alive by the physician, the alchemist and the apothecary; medical works like those of Celsus and Galenus in antiquity have been the encyclopedias of the existing knowledge of nature, and celebrities like Boerhave, Linnaeus and Haller in more modern times have been the living centres of all the natural sciences. The same uniting bond has not been wanting in our (nineteenth) century, when it has again, as many times before, manifested its powerful influence, has brought together researches which were on the point of falling asunder, and infused new life and interest into the driest of studies. . . . The modern school of medicine originated in the attempt—begun by Lavoisier in France, but carried out

on the largest scale in the chemical and physiological laboratories of Germany—of making the new discoveries in physical science and chemistry fruitful for medical purposes and the treatment of pathological cases." [22]

In all the arts and industries this practical usefulness of mathematical and experimental researches is evidenced. "In these [arts and industries] we do actually abstract the possessions of nature from their proper hiding-places; we drag the minerals from the bowels of the earth; we cut up the timber of exotic growth into artificial fragments; we break up that natural equilibrium in which electrical and chemical agencies have, for thousands of years, evaded our discovery and our regard. Having done so, we create an artificial world of our own making which ministers to our wants, comforts, pleasures, and supplies that most inestimable of all commodities of civilisation, varied and stimulating work for ready hands and active brains. The wants and creations of artificial life have thus proved the greatest incentives to that abstract and artificial treatment of natural objects and processes for which the chemical and electrical laboratories of the mathematician on the one side, and the workshop and factory on the other, have in the course of the (nineteenth) century become so renowned." [23]

These two interests—that of the naturalist and that of the practical man—are the chief stay of the popular confidence in Physical Science. At the beginning of the twentieth century specialists discussed amongst themselves whether the hypotheses which are at the base of the scientific theories now most generally accepted were to be regarded as physical realities or convenient fictions. This momentous discussion ended in hopeless confusion: one set of specialists held that the atomic and ethereal hypotheses were convenient fictions—"a person who thought a river was really a streak of blue paint might learn as much about its direction from a map as one who knew it as it is" [24]; another set of specialists held that the atomic and ethereal hypotheses were physical realities—"the wreckage of rejected theories is appalling, but a knowledge of what actually goes on behind what we see or feel is surely if slowly being attained" [25]; a third set held that atomic and ethereal hypotheses were a blend of fact and fancy, but that it was difficult to say where the one ends and the other begins—"a man peering into a darkened room and describing what he thinks he sees may be right as to the general outline of the objects he discerns, wrong as to their nature and their precise forms." [26] And apart from all these groups, you had the Energists denouncing atoms and ether as utterly misleading fictions of the scientific imagination. But the public heeded not and heeds not these worries of the master-minds of Physical Science. So long as Physical Science describes the beauties of lifeless bodies as they are, so long as it calculates and foretells accurately the happening of perceptible events, the

public is content: the naturalist and the practical worker take no interest in the deeper aspects of Physical Science.

THE MANUFACTURE AND DIFFUSION OF IRRATIONAL SCIENCE.

"Sir William (Kelvin)"—writes Professor Thompson, quoting Dr. Hutchinson,—"in my time had three favourite subjects, on each of which he was sure to go off at a tangent whenever the smallest opening was presented. One of these was the Cambridge system of examinations. . . . Equally severe he was on our insular barbarous system of weights and measures. . . . But Sir William's anger on these two subjects was as nothing compared with what it was on the third. This was—Hegel. If you wanted to see an illustration of pure white heat you should have seen Sir William castigating Hegel for the audacity of his assaults on the Newtonian philosophy. I remember on one occasion he sent over to the library for the learned volume containing Hegel's criticism of Newton in order that we might hear the *ipsissima verba*, the downright nonsense of this 'arrant impostor'. I remember the expression perfectly both from its native force and the vehemence with which it was uttered. . . . In my time nothing was more characteristic of Sir William than the thoroughness with which he thrashed out every subject he took up. His students were persuaded that he knew everything about a subject that could be known, and they felt he was perfectly justified in his sometimes rather unsparing language about charlatans, 'showmen,' mere brilliant experimenters who wished to pose as philosophers. In fact, our faith in him went so far that I have heard some of the best students say they were hardly satisfied with any philosophical theory till it had Sir William's *imprimatur*, and were almost content to accept it as all right if it got that.

"The particular passage"—continues Professor Thompson after concluding this quotation from Dr. Hutchinson—"in Hegel which aroused Sir William to scorn was the attack on Newton's theory of planetary motion around the sun: '*The motion of the heavenly bodies is not a being pulled this way or that* (*such as imagined by the Newtonians*) *but is free motion; they go along as the ancients said, as blessed gods. The celestial corporeity is not such a one as has the principle of rest or motion external to itself. Because stone is inert, and all the earth consists of stones, and the other heavenly bodies are of the same nature, is a conclusion which* (*wrongly*) *makes the properties of the whole the same as those of the part. Impulse, Pressure, Resistance, Friction, Attraction, and the like, are valid only for an existence of matter other than celestial. . . .*' 'Hear his words!' Sir William would say. 'If, gentlemen, these be his physics, think what his metaphysics must be.' It was perhaps his hatred of the school of thought which exalts wordy description about rigid demonstration, that gave Lord Kelvin more or less of a bias against all metaphysics, and to some extent against all non-symbolic philosophy. Herein he differed greatly

from Helmholtz, whose habitual philosophical thought was of far wider sweep. He did not even appreciate the achievements of the greatest of contemporary English leaders in philosophy, for he wrote: I have never been of opinion that the philosophical writings of the late Mr. Herbert Spencer had the value or importance attributed to them by many readers of high distinction. In my opinion a national memorial would be unsuitable.

"Lord Kelvin's contempt for metaphysics was often expressed in the interjected *obiter dicta* of his class-room. 'Mathematics is the only true metaphysics,' was another saying. . . . The following story was narrated by Lord Kelvin himself when dining at Trinity Hall. A certain rough Highland lad at the university had done exceedingly well, and at the close of the session gained prizes both in mathematics and in metaphysics. His old father came up from the farm to see his son receive his prizes, and visited the college. Thomson was deputed to show him round the place. 'Weel, Mr. Thomson,' asked the old man, 'and what may these mathematics be, for which my son has getten a prize?' I told him, replied Thomson, that mathematics meant reckoning with figures, and calculating. 'Oo ay,' said the old man, 'he'll ha' getten that fra' me; I were ever a braw hand at the countin'.' After a pause he resumed: 'And what, Mr. Thomson, might these metapheesics be?' I endeavoured, replied Thomson, to explain how metaphysics was the attempt to express in language the indefinite. The old Highlander stood still and scratched his head. 'Oo ay, maybe he'll ha' getten that fra' his mither. She was aye a bletherin' body.'" [27]

I hold no brief for Hegel or Hegelianism. But it is worth the reader's while to give some attention to this illuminating account of the manufacture and diffusion of irrational science in the nineteenth and twentieth centuries by men whose physical and mathematical achievements rightly won a world-wide reputation. This extract cannot be dismissed as the fabrication of an enemy of science: it is taken from a biography begun in 1906 with Lord Kelvin's co-operation, and based at every stage of its progress upon the accounts of many prominent colleagues and old pupils of Kelvin. It is, then, an authentic account furnished by men who lived and worked at some of the most famous centres of contemporary scientific thought. Now, Kelvin was an outstanding figure in his own special domain of work. So was his biographer, Professor Silvanus P. Thompson. Both of them spent their lives at pursuits in which extraordinary patience of judgment and rigorous accuracy of research are essential to that genuine success which was theirs. We might reasonably expect, then, that even the *obiter dicta* of such men in branches of study wholly distinct from their own would show some trace of that profound veracity which is the secret of the truth-seeker in every department of research.

But, in their attitude to Hegel and to Metaphysics, we find ourselves confronted with an exhibition of prejudice that is

redolent of the methods of the Homeric and Hesiodic poets. Lord Kelvin refutes Hegel's system of Objective Idealism by quoting for the raw youths of Glasgow University an extract of less than a dozen lines. With the skill of a practised showman, he strives to add solemnity to this farce played upon a callow audience by sending from the class-hall to the library for a volume of Hegel. Dr. Hutchinson, a Glasgow Headmaster, regales the readers of the *Glasgow Herald* with picturesque details concerning this gigantic intellectual feat. Kelvin entertains his colleagues in Hall with the verdict of a Highland peasant on the value of "metapheesics." Kelvin spurns Spencer. Poor Spencer! His evisceration of the philosophy of matter ought to have been complete enough for Kelvin the kineticist. Probably, his views in biology and in anthropology had angered Kelvin the theologian. Then, we have Professor Thompson piously retailing these doughty characteristics of his hero: giving in a note Hegel's passage in the original German, in order, as he tells us, that readers may better understand its illogical silliness; contenting himself with a perfunctory admission of the vastly greater mind of Helmholtz; betraying his own mentality by styling Spencer the greatest contemporary English philosopher. Nor are those irrational scientific prejudices limited to Kelvin and his associates. Anyone who reads the *obiter dicta* of other militant scientists about metaphysics cannot doubt but that, in this short and easy method of damning metaphysics, Kelvin had and has a large following in the English-speaking world among the zealots of physics and mathematics. And in our full-crammed and much-examined generation, irrational science of this kind spreads as quickly and as widely as influenza.

The kind of solemn nonsense that is manufactured and spread by methods like these may be aptly illustrated by applying them to the astronomical achievements of Sir Isaac Newton. "If Sir Isaac Newton," says Sir David Brewster,(28) writing at about the time Kelvin began those famous onslaughts in class on Hegel, "had not been distinguished as a mathematician and a natural philosopher, he would have enjoyed a high reputation as a theologian." And Sir David mentions first among the principal theological writings of Sir Isaac, the work: *Observations upon the Prophecies of Daniel and the Apocalypse of St. John.* The student who has the curiosity to unearth this volume from some old library will get the lesson of his life about the worth that ought to be attached to the studies of a physical and mathematical genius when off his beat. This vaunted book is a mine of seventeenth-century Protestant fables about the Pope and the Catholic Church presented adroitly under the guise of a historic vindication of the truth of certain prophecies in Daniel and in St. John.(29) All the strong phrases of Daniel that used to appeal so much to Protestants are emphasised by Sir Isaac: the eleventh horn of the fourth Beast who speaks great words against the Most High and wears out the Saints until a time, times and

half a time; the king who reigned with a look more stout than his fellows, and into whose hands times and laws were given; the judgment that is to sit after a time, times and half a time, and the transference by degrees unto the people of the Saints of the Most High whose kingdon is to be everlasting; the king who shall exalt himself above every god and shall not regard the god of his fathers, nor the desire of women, and shall honour with gold and silver and precious stones and pleasant things a god whom his fathers knew not; etc., etc. Sir Isaac emphasises in a similar manner the favourite texts of primitive Protestantism in the Apocalypse: at the opening of the fifth seal, the woman clothed with the sun and moon but who is beginning to go astray and to need admonitions; the change in this glorious woman owing to her arrival at temporal dominion on the back of the Beast where she is fed from the face of the serpent, is nourished by the merchants of the earth, made drunken with the blood of Saints until at last she is clearly recognisable as the iniquitous eleventh horn of Daniel's fourth Beast; the second Beast who rose out of the earth and had horns like the Lamb but spoke like the Dragon and was, therefore, of the Dragon's religion; the final apostasy of the woman when her corruption is signalised by her being divided into the great whore of Babylon and the two horned Beast; at the opening of the seventh seal, the prevalence of the Great Apostasy and the revelation of the Man of Sin; the excommunication of all who had not the mark or name or number of the Beast; and so on—until we come to the 144,000 who are sealed out of the twelve tribes of Israel and become the Two Witnesses of the true Church in all times and places. Sir Isaac delighted the heart of the Kensitites of his time by the unfailing accuracy with which page after page he pointed out the unmistakeable fulfilment of all these iniquities in the superstitions of the Roman and of Greek Churches—the Papacy, celibacy, purgatory, image-worship, ghost-worship, demon-worship, relic-worship: his skill never fails him for a moment in showing exactly which one of these superstitions was present to the minds of Daniel and of St. John as they wrote line after line of their prophecies. And when this labour tires himself or his readers he enlivens his pages with delectable tales about the temporal intrigues of the Pope, about the source of the splendid oblations made at Rome, and about the origin of the practice of kissing the foot of the Pope. All this mischievous nonsense was food and drink to Newton himself as well as to his contemporaries. There is no more dogmatic or testy mortal than the mathematician or the scientist who starts writing on topics which his special studies never permitted him to explore thoroughly. Newton was no exception. When Halley once ventured to jest with Sir Isaac about these theological by-products, he curtly repulsed him with the remark: "I have studied these things; you have not!"

Kelvin was, despite his extraordinary talents, no Newton. But he had, just as Newton had, a streak of the lay theologian in

his temperament. He was a conscientious bible-reader and, late in life, became President of the Largs and Fairlie Auxiliary of the National Bible Society of Scotland. "Of sacerdotalism and ritualism in all its phases and forms he had an unconcealed detestation. He even went so far as to write that the only sense in which he could regard the High Church as high, was the same as that in which game is said to be high—when it is decomposing." (30) Moreover—and this is apparently another unconscious portraiture of a delightful trait—"he was strongly opposed to the secular solution of the religious difficulty in primary education. He was equally strongly opposed to denominationalism in schools, particularly in Ireland." (31) This being our man once he left his laboratory, it is not safe to assume that Kelvin would dissent from any of Newton's conclusions in the *Observations*. Happily, the truth or falsehood of these conclusions is nowadays of no practical concern. And, at any rate, our chief interest lies in the method of proof by which the giant mind of Newton reached these conclusions. Newton employed of course all the cabbalistic arts of preceding Protestant interpreters: time is a calendar year of 360 days; locusts are Turks; the lives of locusts are five months; but the locusts of the prophecy had two lives—five months at Damascus and five at Bagdad; thus we arrive at ten months or 300 prophetic days which are the years from 637 to 936 inclusive; and so on *ad nauseam*. But his chief proof of the historical allusion of these prophecies had the simplicity of genius: he quotes in italics a text of Daniel or of St. John; and, at intervals, he interpolates in non-italicised letters such words as make each text refer to the superstition at which he decrees it must have directed. *Ab uno, disce omnes.* Here is his proof that celibacy was prophesied to be an unscriptural superstition in Daniel (xi. 37): "*Neither shall he regard the* lawful *desire of women* in matrimony." (32) Proofs like these—there are none other in this volume of Newton—must appear to the profane eyes of every unprejudiced reader to be bare shams: yet, Newton's anger with Halley shows that, in the seventeenth century, these shams, naked but not ashamed, paraded in the highest scientific circles of Protestant England. Now if Kelvin's prejudice against sacerdotalism and ritualism had not deprived him of the use of reason, he ought, had he ever read this volume of Sir Isaac, to have been shocked at the silliness of mind which professed to reach truth by these childish sophistries. Suppose he was thus shocked, can you imagine him interrupting his class-work and sending to the library for Sir Isaac's *Observations* in order that Dr. Hutchinson and the others "might hear the *ipsissima verba*, the downright nonsense, of this arrant impostor"? And when he had read proofs like those just quoted would he exclaim heatedly: "Hear his words! If, gentlemen, that be his way of proving facts about human beings, think what the value of his celestial mechanics must be!"? Not he. And would Kelvin when dining in Hall, tell his colleagues about the old Highlander who, on

hearing of his son's success in Protestant Prophesying and in Newtonian Astronomy, said: "He'll ha' getten the gift of interpretin' prophecy fra' me, I were ever a braw hand at No Popery; maybe he'll ha' getten the star-gazing stuff fra' his mither, she were aye a bletherin' body"? Not he. Had Kelvin been foolish enough to amuse his students and his colleagues by exposing the sham proofs of Newton, would Dr. Hutchinson on the occasion of Lord Kelvin's elevation to the peerage retail such feats amongst his lively reminiscences for the entertainment of the readers of the *Glasgow Herald?* Would Professor Thompson reverently gather them all into the official biography? Would he quote the original text of Newton's *Observations* in order to show his readers more clearly its illogical silliness? No: if Professor William Thomson had signalised his teaching at Glasgow by meting out to Newton the kind of treatment he found popular in the case of Hegel, Othello's occupation was gone. There never would have been a Baron Kelvin of Largs whose metaphysical prejudices might safely be boosted and endorsed by Dr. Hutchinson and Professor Thompson. Not he. Not they. There is honour among thieves. But Kelvin and the Kelvinites make no scruple of attempting to wield, against Hegel, controversial methods so utterly unfair that they might be employed far more successfully to blast, in the minds of the half-educated, the fame of the author of the *Principia.* Yes: any stick is good enough to beat a dog so long as you know the onlookers to be either uncritical or indolent.

But what about the extract from Hegel? Many who would disdain to take any personal part in that kind of propaganda against Hegel, which was carried on so long and with such gusto by Kelvin and his admirers, will urge that, after all, the incriminated extract deserved some kind of public castigation at the hands of the votaries of mathematical physics. That is not so. Read the passage for yourself in the original, and you will see that this academic lynching was initiated and pursued on a bogus charge. The mathematical and physical implication of the extract is simply that gravitation is not an ultimate property of matter. That view—from a different standpoint—was the guiding idea of every kinetic theory which Kelvin, at different periods of his life, either suggested or supported. The scientific and mathematical proof of such a view eluded the scientific experts of Kelvin's day. Some think that Einstein has brought it within the reach of our generation. But, whether gravitation be or be not an ultimate property of matter, there is not a word in the incriminated extract, or indeed elsewhere in Hegel, that puts the slightest restriction on the free play, in its appropriate sphere, of the methods and achievements of mathematical physics.

The upshot of all this discussion about the manufacture and diffusion of irrational science is, that, despite the genius of the one and the extraordinary talent of the other for mathematical and scientific research, we have discovered in Sir Isaac Newton

as lay interpreter of Daniel and the Apocalypse and in Sir William Kelvin as lay interpreter of Hegel and Metaphysics, the immortal cockney of Dickens. "'God bless me, what is the matter?' This last was an ejaculation of irrepressible astonishment, occasioned by seeing Mr. Pickwick, in his enthusiasm for discovery, fall on his kness before the little stone and commence wiping the dust off it with his pocket handkerchief. . . . The astonishment of the village may easily be imagined, when (the little stone having been raised with one wrench of a spade), Mr. Pickwick, by dint of great personal exertion, bore it with his own hands to the inn, and after having carefully washed it, deposited it on the table. The exultation and joy of the Pickwickians knew no bounds, when their patience and assiduity, their washing and scraping, were crowned with success. The stone was uneven and broken, and the letters were straggling and irregular, but the following fragment of an inscription was clearly to be deciphered:—

†

B I L S T

u M

P S H I

S. M.

A R K."

The Purpose of Modern Cosmology.

These sketches of modern physics and modern mechanics may help the beginner to realise the genuine meaning of the methods and results of modern physical science. But the present volume shall introduce him only to thinkers who had none of the worries raised by the enormous progress in its own domain of modern science. The thinkers of Greece were at once scientists and philosophers. The thinkers of the Middle Ages went one better: they were scientists, philosophers and theologians. Those days,—when knowledge despite its originality and depth was so limited in extent that anyone who had brains enough to be an expert in anything might, if he chose, be an expert in everything—are over centuries ago: Leibniz was the last to make any kind of successful attempt at this kind of encyclopædic learning; he did not succeed wholly, and every later attempt was that of a charlatan. Modern progress in knowledge has become possible only since men began to realise that this boasted mastery of all knowledge was really an obstacle to mental progress. For centuries past, the fundamental condition of progress in research has been the division of labour, the restriction of individual inquirers to limited provinces and the investigation of those provinces as a life-work. That is

why nowadays the philosopher ought to be simply a philosopher and the scientist simply a scientist: *ne sutor ultra crepidam.* "It is true, of course, that other things being equal, the better stored the mind of the philosopher with scientific facts, the sounder will be his judgment on the interpretation and implications of the whole body of facts. But, at the same time, the gifts which make a successful experimentalist and investigator of facts are not altogether the same which are required for the philosophical analysis of the implications of facts, nor are both always conjoined in the same man. There is no reason, on the one hand, why the able experimenter should be compelled to desist from the discovery of the facts of nature until he can solve the philosophical problems presented by the very existence of a world of physical facts; nor, on the other, why the thinker endowed by nature with powers of philosophical analysis should be forbidden to exercise them until he has mastered all the facts which are known by the specialists. What the philosopher needs to know, as the starting-point for his investigation, is not the specialist's facts as such but the general principles which the specialist uses for their discovery and correlation. His study is a 'science of sciences' not in the sense that it is a sort of universal encyclopædia of instructive and entertaining knowledge, but in the more modest sense of being a systematised reflection upon the concepts and methods with which the sciences, and the less methodical thought of everyday practical life work, and an attempt to try them by the standard of ultimate (reality) and intelligibility." (33)

Cosmology, then, means the critical examination of the consequences involved in the recognition of matter as a distinct class of existent and of the more general hypotheses, employed by popular thought and scientific reflection respectively, for the explanation of matter and its properties. Hence the work of Cosmology may be said in modern times to begin where that of the empirical and mathematical sciences leaves off. Its data are not so much the particular facts directly amassed by experiment and observation, but rather the hypotheses used by the experimental and mathematical sciences for the co-ordination and description of these facts. And it examines those hypotheses not for the purpose of modifying their structure so as to include new facts or to include the old facts in a simpler way, but purely for the purpose of estimating their value as an account of the ultimate reality of matter. Whether these hypotheses are adequate as implements for the purposes of the natural scientist is a question which Cosmology, as I understand it, leaves entirely to the professors of physics and of mechanics. Whether these hypotheses can claim to be more than this, whether they can claim to give us a grasp of the ultimate nature of matter and its properties, is a problem that can be dealt with only by that science which professes to attempt a systematic analysis of the real meaning of matter—Cosmology.

The empirical and mathematical sciences of matter differ from

one another not because they deal with different parts of the world of matter but because they deal with all that world from different points of view. Physics deals with the weight, sound, light, heat, electricity, magnetism, and local motion of matter. Crystallography deals with the geometric shapes of matter. Mineralogy deals with the minerals of which the crust of the earth is composed: classifying them physically, chemically, and geologically. Chemistry deals with the factors and conditions of chemical change in matter. Geology investigates the manner of formation of our globe. And so on. There is no need, then, for Cosmology to pretend to deal with facts that lie outside the province of these and cognate sciences of matter. It shall have verified its right to be accepted as a science alongside these others, provided it can show that it deals with matter and its qualities from a point of view which is not that, of any one or of all, of these sciences. The only sufficient answer to those who deny the possibility of this cosmological point of view is to work out a systematised body of conclusions distinct from those reached in these modern sciences of matter. This I shall endeavour to do in the second volume of this work. All that can be done here is to utilise the information already given, in this Introduction, for presenting the kind of questions which, modern Cosmology claims, can and ought to be raised about matter and its properties.

The world of matter appears to the plain man to be composed of a multitude of apparently independent, inanimate, bodies: each of these bodies appears to him to be in some sense a unitary being; each of them appears also to possess an indefinite number of qualities; each of them appears to be caught up in a web of connexion with the others—acting on these others and being in its turn acted on by them in a variety of ways. The student of Physics or of Mechanics has a different view of that same world of matter. The classical Physics aimed at accounting for that world in one or other of several ways: mobile massive particles without indwelling central forces; mobile massive particles with indwelling central forces; protons and electrons with varying and extrinsic mass. The classical Mechanics aimed at accounting for that world by mass and mass-acceleration; "in abstract dynamics, matter is considered under no other aspect than as that which can have its motion changed by the application of force" (34); in abstract dynamics, force answers to the differential coefficient of the distance as a function of the time, or "is no more an objective entity than say 5 per cent. per annum is a sum of money." (35) And when we pass from the classical Physics and the classical Mechanics to their respective "romanticisms" as represented at the moment by Rutherford and Bohr, by Planck and Einstein, stranger tales still are suggested of what lies behind the plain man's view of material bodies and their qualities: tales not yet fully told by their authors, tales whose consequences no scientist or mathematician can foretell.

These views of the plain man, the physicist, and the mechanist,

are as far apart as the poles. Add to these existing chasms, the possible volcanic eruptions consequent on the developments in Physics and Mechanics which I have styled romantic. *Immane quantum discrepant!* Now the vital question in Cosmology is the simple one—How far and in what sense can any, or all, of these views be true of the reality of matter and of the reality of its properties? And here are some of the questions that must be asked in trying to face that simple problem. What is the genuine reality corresponding to the mass-points of the classical mechanists or the non-massive electrons of electro-mechanics? The most widely supported views in our days, outside the Scholastic School, come as a shock to common sense: these non-scholastic theorists tell us that the ultimate entities of the mechanist are either purposive beings or unextended forces. Can either of these be true? Both, apparently, fit in admirably with all that Physics and Mechanics can and do teach. So it is little use to appeal to such sciences for a solution. The next question of paramount interest is the existence or non-existence as formal extra-mental realities of the proper sensibles. Democritus, Descartes, and nearly all modern scientists declare these to be sense-illusions. Aristotle, the School and many modern Hegelians declare them to be objective realities. Where is the truth? And if the proper sensibles are not mere sense-illusions, what is their relation to material substances: are they separable accidents or are they inseparable modes of substance? Then, the question arises of the apparent unity of the ultimate particles of matter. If these particles are either psychic entities or unextended forces, that worry is easily solved. But for the man who sticks to formal extension, this worry looms large. How can that, which is neither living nor conscious and yet has parts outside parts, be in any genuine sense a self-subsisting being? That problem was obvious to Aristotle and the School: for them every paving-stone was a single substance—not to talk at all of the Rhine or the Atlantic. But it is not got rid of by being buried in the ultra-atomic entities of contemporary Physics. A scale model of an atom as big as the dome of St. Paul's in London would, we are told,[36] display its electrons as little larger than pin-heads, and its protons as dust particles invisible to the naked eye. The nucleus of this atom is said to consist of all the positive electricity and about half of the negative electricity: that is, of all the protons and about half the electrons. This nucleus is extremely small compared with the whole atom: thus, if we represent the nucleus of the atom of helium—consisting, it is alleged, of four protons and two electrons—by a rather large pea, its planetary electrons may be represented on the same scale as two rather small peas revolving round it at a distance of a quarter of a mile. This is tininess with a vengeance. Still, if any part of the nucleus or of the planetary electrons be formally extended that part has a North and a South, an East and a West, as truly as the continent of Europe. Now the continent is only a unit of matter in a

metaphorical sense: but those who refuse to declare formal extension a sense-illusion must allow the ultimate continuous infinitesimal particles of matter to be a substance, that is, to be a unitary centre of existence and of activity. How can this be? How can this extended manifold exist and act as a unitary being? Science does not worry about the fact. Cosmology must so worry or else cease chattering about the existence of extended substances. And when the cosmologist is done with the question of substance, that of cause engages his attention. The plain man believes in the interaction of material bodies. Science accounts for that interaction by the communication of motion from one body to another. The fact is undeniable, but how can it occur? Do bodies when they collide share their motions as men exchange moneys when marketing? Can bodies shed their motion as snakes slough their skins? Is motion a kind of internal liquor which bodies can emit and pass on to their neighbours, just as restless spiders in autumn emit from their spinnerets those fine separate threads of silk that speed through the air as showers of gossamer to settle down on hedge-row and moor? And if to escape these absurdities, the alarmed student plumps for indwelling central forces, he appears to be stepping gently from the frying-pan into the fire. Motion is motion; there is no gainsaying that. But force—what is that? A cause of motion? Where does it reside? In the protons or electrons or some infinitesimally small lump of matter? And how? Are forces stuck in substances like currants in a cake? And when a force is diminished by action and reaction, does this mean that the force is extracted from the substance somewhat after the manner in which a currant is picked out of a cake by a child?

These are some of the questions that arise out of the simple problem set the cosmologist of finding out whether and how far the plain man, the physicist, or the mechanist, is speaking the ultimate truth about matter and its properties. With the single exception of that one about the reality or illusion of the proper sensibles, none of these questions is ever discussed in Physics and Mechanics or any of their sub-branches. There is, then, a big field for the cosmologist. And if it be said that all these questions of the cosmologist, intelligible as they are, are unanswerable, the answer is obvious. You never know till you try, and you cannot make that trial without wading through the pages of Cosmology. Even should that trial convince you that the quest of the cosmologist, alluring though it seem, is nothing else but a chase after a will o' the wisp, your labour is not lost. You have crossed the chasm between ignorant learning and learned ignorance.

The Utility of Cosmology.

Where ignorance is bliss, 'tis folly to be wise: this is apparently the most powerful piece of heavy artillery in the armour of certain critics of Cosmology. In showing its feebleness, St.

Thomas takes high ground: a sound philosophy of matter is essential to a sound philosophy of theism, and a sound philosophy of theism is essential to a sound defence of Catholicism. But before citing this argument of St. Thomas and the commentary thereon by Leo XIII. and his successors, I would suggest other considerations more level with the mental outlook of this kind of critic: there is no accounting for tastes: beggars can't be choosers.

There is no accounting for tastes. There are men to whom Hunger and Love, Work and Play are the only things worth while. There are men whose supreme interests are State and Church or either of these. There are men whose supreme interests are Art and Literature and Science or one of these. Similarly, there are men whose supreme interests in life are speculative: men for whom the effort to give some rational account of the riddle of the universe is an irresistible passionate desire. Revealed Religion knows in the realm of intellect no more powerful friend, no other foe, than these rationalistic seekers after the Infinite: the metaphysics of St. Thomas and Duns Scotus saved the Catholic universities of medieval Europe from the paganism of Averroism; the metaphysics of Spinoza and Kant left the Protestant universities of modern Europe an easy prey to every form of revived Paganism. Now, it is from such seekers after the Infinite that Metaphysics gathers age after age its votaries: for them, the study of Metaphysics is its own justification and its own reward.

Beggars can't be choosers. Lazarus must eat of the crumbs and must allow his sores to be licked: if he eat not, he dies; if he be not licked, he rots. Every man is in a similar plight with reference to Metaphysics. The most complacent non-metaphysician and the most virulent anti-metaphysician accept or advocate some particular solution or no-solution of the riddle of the universe: they may never be aware of the existence of such a branch of learning as Metaphysics, or they may never have given a moment's thought to its value; yet, the existence of Metaphysics is at the root of all those safeguards against facile and random theories of life and life's aim, which tend to destroy the spontaneous moral vigour of that environment in which our critics live and whose standards they accept. It is puerile, then, to talk of the uselessness of Metaphysics: every child of Adam is, in reference to Metaphysics, a Dives or Lazarus or a something between these extremes. None of us can avoid having some kind of Metaphysics: if our Metaphysics be not conscious and rational, it will certainly be unconscious and will run the gravest risk of being irrational. Our one hope is to be as metaphysical as our talents and our opportunities permit: otherwise the likelihood is that, on the great problem of the ultimate purpose of human life, we may be but travelling "from the smoke into the smother."

Metaphysics at the root of the gravest issue in human existence? Perhaps, when it deals with the soul or with God

but—Cosmology, the Metaphysics of sticks and stones, of clouds and rainbows? "No man dare despise," writes St. Thomas,[37] "the science treated in this book (*Meteor.* iv.) or indeed any part of the science of nature: in fact, he who despises natural science despises himself. It is true that many writers make little of the natural sciences on the ground that such sciences are useless for that speculation about divine truth which is, as the Philosopher says in the tenth book of the Ethics, the happiest and most desirable life for man. Such writers, however, are mistaken. The science of this book and all the sciences of nature—not merely those which deal with general truths but also those which deal with particular facts and the properties of each being—are helpful in making God known to us: for we arrive at a knowledge of causes by starting from those obvious and natural facts which are their effects. That is why the Philosopher in his Metaphysics begins with perceptible substances and in the twelfth book proceeds to prove by astronomical reasoning the nature of separated substances. That is why no matter what science we are studying, we study it for the purpose of a knowledge of divine things: indeed, any other motive in the study of science is perverse except in the case of those who have to study science for a livelihood." This is the language of a metaphysician who was also evidently a man of common sense. Leo. XIII. and his successors are never weary of reminding the Catholic schools of this broad outlook of St. Thomas. These Pontiffs insist that all hopes of the Catholic Church ever recovering that ascendancy which she has lost over the intellect of Europe depend on a sound Philosophy, and that all hopes of a sound Philosophy depends to-day on an alliance with Physical Science. If that be so, Cosmology—the philosophy of matter—must be worth a good deal to the Catholic student.

Method in Cosmology.

"There are three different ways in which the criticism of philosophic, of all speculative opinion whatever, may be conducted. The doctrines of Plato's *Republic*, for instance, may be regarded as so much truth or falsehood, to be accepted or rejected by the student of to-day. That is the dogmatic method of criticism; judging every product of human thought, however alien or distant from one's self, by its congruity with the assumptions of Bacon or Spinoza, of Mill or Hegel, according to the particular mental preference of the particular critic. There is, secondly, the more generous, eclectic or syncretic method, which aims at a selection from contending schools of the various grains of truth dispersed among them. It is the method which has prevailed in periods of large reading but with little inceptive force of their own, like that of the Alexandrian Neo-Platonism in the third century, or the Neo-Platonism of Florence in the fifteenth. Its natural defect is in the tendency to misrepresent the true

character of the doctrine it professes to explain, that it may harmonise thus the better with the other elements of a preconceived system.

"Dogmatic and eclectic criticism alike, have in our century, under the influence of Hegel and his predominant theory of the ever-changing 'Time-spirit' or *Zeit-geist*, given way to a third method of criticism, the historic method, which bids us replace the doctrine, or the system, we are busy with, or such an ancient monument of philosophic thought as the *Republic*, as far as possible in the group of conditions intellectual, social, material amid which it was actually produced if we would really understand it. That ages have their genius as well as the individual; that in every age there is a peculiar *ensemble* of conditions which determines a common character in every product of that age, in business and art, in fashion and speculation, in religion and manners, in men's very faces; that nothing man has projected from himself is really intelligible except at its own date, and from its proper point of view in the never-ending 'secular process'; the solidarity of philosophy, of the intellectual life, with common or general history; that what it behoves the student of philosophic systems to cultivate is the 'historic sense': by force of these convictions many a normal, or at first sight abnormal, phase of speculation has found a reasonable meaning for us. As the strangely twisted pine-tree, which would be a freak of nature on an English lawn, is seen, if we replace it, in thought, amid the contending forces of the Alpine torrent that actually shaped its growth, to have been the creature of necessity, of the logic of certain facts; so, beliefs the most fantastic, the 'communism' of Plato for instance, have their natural propriety when duly correlated with those facts, those conditions round about them, of which they are in truth a part." (38)

Pater—from whom I take this excellent account of the three different ways of studying philosophical opinions—was mistaken in thinking that Hegel introduced the historic method of criticism into the study of philosophy: being probably led to this conclusion by the fact that, as Descartes and Kant had neglected the historic method, Hegel's reintroduction of a method as old as Aristotle seemed to many the invention of a new way of philosophising. Chief among Aristotle's services to rationalism was his insistence on historic criticism as a necessary preliminary to systematic study of any subject: he did this in Politics; he did this in General and in Special Metaphysics. He opens his *First Philosophy*, his first treatise on *Physics*, and his *Treatise on the Soul* with detailed historic criticism of his predecessors. The introduction to his *First Philosophy* consists of a whole book containing nine chapters devoted solely to the historical exposition of the views of his predecessors in Ontology and Rational Theology. The introduction to his first treatise on *Physics* consists of a whole book of nine chapters similarly occupied with the views of his predecessors in Rational Cosmology. The intro-

duction to his *Treatise on the Soul* consists of a whole book of five chapters devoted to nothing else but a historical account of preceding Rational Psychology. And as the metaphysical treatises of St. Thomas and of Duns Scotus are really line-to-line commentaries on the text of Aristotle, they and theirs also made the historic method of criticism the basis of their studies in philosophy. Passage after passage of Aristotle, of St. Thomas, of Scotus explain why philosophy should be grounded on the historic method.(39) Here are some passages from St. Thomas. "He (Aristotle) tells us the reasons why here and elsewhere he discusses the opinions of others. . . . It is necessary for the truth-seeker to solve doubts because, as is laid down in the third book of the *Metaphysics*, the solution of doubts is the discovery of truth. And that is why the arguments of our adversaries are a great help in the search after truth. . . . He (Aristotle) gives four reasons for this plan of his (of making the historic method of criticism an essential feature of all his *Metaphysics*). The first is that anyone who seeks after truth must begin by doubting stoutly : because the finding of truth is nothing else but the solving of doubt. Every one knows that a man who cannot see where the knot is cannot untie a bandage. But a doubt in one's mind is like a bandage on one's body and produces the same effect : the doubter suffers inconveniences analogous to those of the bound. When a man's legs are tied he cannot march forward, and when a man has his mind tied up by a doubt he cannot make any progress in speculation. That is why he who wishes to solve any doubt must begin his work by examining all pertinent difficulties and their causes : just as anyone who wishes to untie a bodily knot must begin by studying the knot and the way it is made. His second reason is that those who wish to investigate truth but are unwilling to start with doubting may be likened to travellers who do not know where they are going. The reason is that just as the goal of his journey is intended by the pedestrian, so the overcoming of certain doubts is the goal of the truth-seeker. But it is clear that anyone who does not know where he is going cannot go straight—except by chance : therefore, no one can keep on the right road in the search for truth unless he knows beforehand the doubts of the question. His third reason is as follows. He says that just as anyone who knows not where he is going cannot know when he really arrives at the goal, whether he is to stop there or go farther, so the person who does not know beforehand that doubt whose solution is to be the goal of all his searching can never be sure whether he has found the truth or not : for he does not know the goal of his enquiry—a goal that is manifest to the man who starts with a knowledge of the (pertinent) doubts. His fourth reason is based on the needs of the hearer. It is the function of the hearer to pass judgment on the cases that are at hearing. But just as in the courts no one can act as judge who has not heard all sides, so the hearer of philosophy is better able to act as umpire if he has been told all that the

doubting adversaries have to say for themselves. . . . He (Aristotle) says also that if having begun by stating the views of others and the reasons that induced them to hold such views, we are able to refute their arguments, then it will be clear to everyone that we are not condemning our opponents without grounds as those do who reject the views of other people solely on the grounds of hatred or dislike. Conduct of that kind would be unbecoming in philosophers whose boast it is to be truth-seekers. Those whose aim is to discuss truth and truth only must not take up an attitude of hostility to any of the disputants on whose claims they are about to sit in judgment: their proper attitude towards all parties is that of an impartial investigator and umpire. . . . Note, then, that these are the reasons why Aristotle has the habit—in almost every book of his that deals with the enquiry into and the proof of truth—of beginning with an account of all pertinent doubts."

Aristotle and the Schoolmen did not use the historic method simply for the purpose of following intelligently but with strict indifference the mental processes of their predecessors or adversaries. Their aim as philosophers was to settle the score between reason and unreason as guides of human life. That is, they were as keen on dogmatic and eclectic criticism as on historic criticism: they heard all sides simply because they wished to winnow the grain from the chaff. "We admit," writes Aristotle (40) in the *Ethics*, "that the subsequent inquiry is disagreeable to us on account of the fact that our friends (Plato and his School) have adduced therein (unsatisfying) views. But we must be loyal to truth even to the extent of setting aside their conclusions—especially as we also are philosophers. For although our friends and truth are both dear to us, it is our sacred duty to set truth above friends." "He shows," comments St. Thomas,(41) "that this (his friendship for Plato) must not be allowed to hinder him. For it is better and more virtuous—nay, an inevitable duty—to oppose a friend in the interests of truth. This is so essential to morality that morality is impossible otherwise: for if a man does not estimate truth higher than his friends, he will be led to deliver false judgments and false testimonies in defence of his friends. And that would be immoral. And although this duty of preferring truth to one's friend binds all men as rational beings, it is particularly binding on philosophers who are teachers of wisdom, that is, of the knowledge of truth. Then, he goes on to prove that man must prefer truth to friends by the following arguments. We must honour most our greatest friend. And since we are friendly with both—that is, with truth and with a certain man—we must love truth more than this man because our principal reason for loving the man ought to be the truth that is in him and because our reason for loving truth is itself and nothing else, as shown in the seventh book of this treatise. Truth is, in sooth, a super-excellent friend to whom is due a reverential honour. For, truth is in a sense divine: it is found funda-

mentally and primarily in God. Hence Aristotle concludes that it is a sacred duty to love truth more than friends. Sanctity—as Andronicus the Peripatetic says—makes people staunch and inflexible in the service of God. Plato is of the same mind. For when setting aside an opinion of Socrates who was his master, he declares that one must be more careful of truth than of anything else. And he says elsewhere : Socrates is a friend but truth is a greater friend. And in another place he writes that one may make little of Socrates but one must make much of truth." The pith of this rigorous rationalism cannot be put with greater precision and terseness than in another text of St. Thomas. "The purpose of philosophy is to know, not the thoughts of men, but the truth of things." (42)

The present treatise has been written on this plan so familiar to the student of Aristotle and the School : it aims at placing each cosmological system as far as possible in the intellectual conditions amid which it was actually produced ; it regards all these contending systems chiefly as so much truth or falsehood to be accepted or rejected as such by the student of to-day : it strives to select from the welter of systems the various grains of truth dispersed among them. As I went ahead with the enquiry, I found the fruitful development of Cosmology fell naturally into two periods : an ancient and a modern period. The ancient period stretches in Greece from Thales to Aristotle, and in Europe from Albert the Great to Suarez and his first disciples. That earlier period marks the victory and the consolidation of Aristotelian Cosmology. The modern period in Cosmology opens with the rise of modern physics and modern mechanics, and still continues. Its chief characteristic is a double bias against Aristotle and the Schoolmen : the dominant views in experimental and mechanical science are wholly anti-Aristotelian ; and the modern fashionable philosophies of matter pay little or no attention to Aristotelianism.

The volume that is here presented to the reader covers the ancient period of cosmological speculation : roughly from Thales to Suarez. It begins with an account of the growth and maturity of Aristotelian cosmology in Greece. Passing from ancient Greece to medieval Europe, it proceeds to unfold the complex cosmological speculation of the Aristotelian Schoolmen. And in the final chapter, it gives an account of the downfall of medieval cosmology. The second volume, which is fairly advanced, will give the sequel of that downfall. It will open with a review of physical and mechanical science from Galileo to Einstein. This review will be followed by an account of the philosophy of matter from Descartes to our own time. I shall merely repeat the tale of the scientists as they themselves speak it : the cobbler must not quit his last. But in reviewing modern philosophies of matter, I shall unfold the grounds for my conviction that the Cosmology of contemporary Scholasticism embodies the best attested results of modern science and modern philosophy.

CHAPTER I.

PRE-ARISTOTELIAN THEORIES OF MATTER.

THE problem of the constituents of matter was the first philosophical problem that attracted the Greek mind: it emerged as soon as the Greeks, grown sceptical of popular mythology, turned to reason for light on the mysteries of experience. It had, therefore, been debated for two centuries before the time of Aristotle: thinker after thinker contributing his item to an ever-growing store of observation and speculation. Asked and answered in the beginning with the frankness and confidence of every fresh mental effort, it had been thrown in later days into almost all possible shapes: and by the close of the fourth century B.C. had received almost all available replies. Some of these replies are as puerile as might be expected of the first attempts of human thought: others carry us forward to the most recent solutions of modern science; all alike claim our attention in this opening chapter because of their bearing on the subsequent development of Cosmology.(1)

THE MILESIANS.

Wonder is the root of all philosophy. Surrounded by the universe in all its varying manifestations of earth and air and sea, the Milesians, these earliest philosophers of Greece, asked themselves what all things were made of. A child's question: yet one that like the rude flint betokens expanding powers of intellect; and one, too, that will worry to the end the mind of man. In propounding their answers, the Milesians relied partly on observation, partly on reasoning. Their observations were prescientific. They believed in some kind of identity between ice and water and steam with, on the one hand, earth and stones, and with, on the other, air and fire. Water froze as ice, and vaporised as steam; ice when frozen harder seemed to become earth and stones; steam when further evaporated seemed to turn to air and fire—the blue of the Mediterranean sky. Then, rain sinks into the ground, becoming earth and all earthy products; and the sun draws up water giving it back as rain; facts like these were taken as proving a ceaseless cycle of transformations. The sun is lighted up afresh each morning in the east; and as he traverses the heavens, is fed by watery exhalations from earth and stream and sea; sometimes he restores these gifts as rain; and every night

he is put out in the west. Such was the naïve scientific outlook of these first philosophers. The principle that lay at the root of their reasoning was the indestructibility and improductibility of reality: creation and annihilation were for them unthinkable.

Thales (fl. 585-4 B.C.), the first Greek cosmologist, was the founder of the Milesian school. Water was, according to him, the primary principle of which all other things were mere transient forms. The reasons which led him to this conclusion are not known. "He (Thales)," writes Aristotle,(2) "was, perhaps, led to this conclusion by observing that the nutriment of all things is moist; that heat itself, by which living things are kept alive, is educed from moisture—but that from which another thing is derived is the principle of that other; and further, by observing that the seed (from which living organisms spring) is of its nature moist—but the principle which makes moist objects moist is water." Aristotle is obviously guessing at the arguments of Thales. Others have taken a similar liberty and have suggested that Thales was influenced by the fact that of all things we know water seems to take the most varied forms: it hardens into ice and rarifies into steam; drawn up as moisture from the sea by the sun, it is made into the fire of the heavenly bodies, and later sent back as rain to earth; and in these days, the alluvial deposits at the mouth of rivers made it natural to think of water becoming earth; and the return of earth to water was the nearest explanation of dews and night-mists and subterranean springs.

Anaximander (fl. 565 B.C.) succeeded Thales. He was so struck by the infinite changes of things that he believed only a spatially endless stuff could account for this inexhaustible supply of new realities. But if the primary stuff must be thus infinite, it cannot be identified with a particular reality like air: for the qualities of air would be so dominant that no other particular reality could have existed. Accordingly, his fundamental stuff is a boundless mass out of which our world of perceptible things emerge by separation. This theory is a compost of mysteries: Anaximander has left us no clear utterance on the nature either of this boundless mass or of this process of separation. As for the mass,(3) the ancients are fairly unanimous in emphasising the distinction between it and the bodies afterwards known as the four elements—earth, air, fire, water; some interpret this boundless mass as a medium between water and air, others as a medium between air and fire; again, others interpret it as a kind of mixture in which all particular bodies are contained; others as a primitive matter without qualitative determinativeness. This last view seems most consonant with the text and context of Anaximander. Hence we may picture to ourselves this principle of Anaximander as a homogeneous bodily mass, indeterminate in quality, and infinite in extent. Out of this boundless stuff, particular bodies emerge by separation. But what exactly this process may be is not explained. Being a hylozoist, Anaximander thinks of matter as self-moved and

alive; and it has been suggested that this separation may be a kind of shaking up and down which sorts out the opposites from the infinite mass. The first result of this shaking is the emergence of heat and cold: the mixture of these produces water, and, though Anaximander rejects the view of Thales that water is the ultimate stuff out of which all things are made, he regards it as the immediate stuff and calls it the seed of the world.

Anaximenes (fl. 546 B.C.), the third and last great Milesian, combines in a new synthesis the theories of his predecessors. He takes over from Anaximander the animation and the infinity of the primary stuff; he reverts with Thales to its definite qualitativeness. Air is the primal substance out of which all things are made. But air meant more for Anaximenes than for us: it means for him as for us invisible air—the breath and the wind; but it means also for him visible air—mist, vapour, darkness. He bases his choice of this primary stuff on an analogy between the universe and living beings: "just as our soul being air, holds us together, so do breath and air compass the whole world." (4) Animal life becomes extinct when breathing ceases; and similarly, earth and water and fire, which exist as islands in that boundless ocean of air surrounding them on all sides, would cease to exist did not the living air hold them together. . . . Simplicius (5) suggests another motive for this choice of air: it is more mobile, more volatile than water, and therefore more fitted for those changes of quality which must be undergone by the primal substance. It is likely also that the popular belief in rain, hail, snow, and fiery phenomena as products of air influenced Anaximenes. His fame rests not on this choice, however, but on his suggestion as to the process by which all things were produced out of air. That process was one of condensation and rarefaction. And although our author did not read into these words all their modern meaning, he certainly made a hit in inventing a phrase that was to have an immense future. Nor is the value of his discovery lessened one whit by its ludicrous basis: the air of the whistle is cold, that of the yawn warm. Rarefaction, then, is heating; condensation cooling. Rarefied air changes into fire; condensed air changes gradually into wind, cloud, rain, earth, stone; and from these simple bodies arise all compound bodies.

The Pythagoreans.

The Pythagorean mathematicians were led, Aristotle (6) writes, by fanciful analogies between the properties of numbers of those of visible things to the view that physical things are made of numbers and that the constituent principles of numbers—the Even and the Odd or the Unlimited and the Limited—are the ultimate principles of things. This doctrine is difficult to grasp, owing both to the lack of historical data and also to the two-fold development of views with the Pythagorean school: none of the earlier writings and only fragments of the

later writings of this school are extant; there is an early or pre-Eleatic Pythagoreanism and a later or post-Eleatic Pythagoreanism.

The gist of early Pythagoreanism—Pythagoras "flourished" 532 B.C.—turns on the meaning of three words: the Unlimited; the Limit; Number. Aristotle [7] says explicitly that the Unlimited of the Pythagoreans is not a quality of any qualitatively determinate body such as fire, water, air or any intermediary; that it is an infinitely extended reality; and that it is outside our world; that this infinitely extended something is not extension as a mathematical abstraction. He tells us further [8] the Pythagoreans held that there was boundless "breath" outside the world; that this "boundless breath" was inhaled by the world; that after the first unit had been formed, the nearest part of the Unlimited was drawn into the process of world-development; that this "boundless breath" thus inhaled kept the units separate from one another; and that the Unlimited is identical on the one hand with the void and on the other with this "boundless breath": an identification supplemented by other suggestions which confound air and vapour, air and darkness. All these hints seem to imply that the early Pythagoreans meant by the Unlimited a boundless extent of breath or air: air, visible and invisible, and therefore including vapour, mist and darkness as well as ordinary air. If this be so, there is a close connexion between the Pythagorean Unlimited and the primary substance of Anaximenes. But in explaining how particular substances are developed out of the Unlimited, these Pythagoreans set aside all suggestions of condensation and rarefaction and teach that the Limit gives definiteness to the Unlimited. They seem to have discovered this function of the Limit in their musical and medical studies. In music, they showed that the concordant elements of the scale—in melodic progressions—could be expressed by simple numerical ratios. Music, then, the purge of the soul, depends on a blend of high and low notes which can be numerically determined. Medicine, the purge of the body, also depends on a fixed blend of opposites: it is the duty of the physician to produce a proper temperament in human bodies "of the warm and the cold, the dry and the moist and things of that sort." Attunement and health, apparently the most elusive realities within human experience, were accordingly viewed by the Pythagoreans as the result of blends that can be expressed in numbers. And if numbers express the inmost secret of music and of medicine, why should they not hold the philosophic secret of the world's brew? But the Unlimited is space-filling. Its limitation, then, must consist in marking it off into regular parts. It would be natural on this hypothesis to regard the point, the line, and the surface, as forms of the Limit. It was characteristic of early Pythagoreanism, however, to think of the point as the first product of the Unlimited and the Limit. The point is a unit having both

position and magnitude.(9) Two points by enclosing a portion of the Unlimited determine a line: Pythagorean lines have therefore breadth. At least three lines meeting together to form angles determine the enclosed Unlimited to a surface: Pythagorean surfaces have thickness. Finally, at least four surfaces joined together at their corners are necessary to determine the enclosed Unlimited to a body. Everywhere, both the Unlimited and the Limit are essential: any two line-forming points would coincide but for the intervening Unlimited; without two such points, the Unlimited would have neither beginning nor end nor direction; but once the presence of the enclosed Unlimited is taken for granted, bodies come from surfaces, surfaces from lines, lines from points. Points, however, are units; consequently all bodies are a sum of units and things are numbers.(10) Numbers? Yes: but from a point of view long since obsolete. The numerical symbolism of these Numbers was quite distinct from the ordinary notation by letters of the alphabet and from the Euclidean representation by lines. It is best illustrated by our present marking of dice and dominoes: numbers were represented by dots arranged in symmetrical and easily recognised patterns; and each pattern was regarded as a fresh unit. A number for such thinkers was a figure or pattern expressing the sum ~~of~~ a series of different kinds: triangular numbers were a series of integers; square numbers a series of odd numbers; oblong numbers a series of even numbers. It is true that this usage has partially survived; we speak as these old Greeks did of square and cubic numbers. "All that we mean by these phrases is that the products stand to their factors in the same proportion as the spatial content of a plane or body to the key-numbers of the lines containing its superficial area or corporeal volume."(11) But these early Pythagoreans apparently took the symmetrical figure to be identical with the number summing up its spatial contents. The dots which stood for the units within these figures or patterns were called terms or boundary stones, and the spaces marked out by them were known as fields. And in this way, number came to be regarded as the principle whence proceeded all reality; the seed out of which things grew. To what depths of puerility this confusion of symmetrical patterns with physical bodies could lend itself is evidenced by the extraordinary methods of Eurytos, one of the foremost leaders in the later Pythagorean school. "Let us assume,(12) for example," he says, "that 250 is the number which defines man, and 360 that which defines plant. Having laid this down, he took 250 counters, some green and some black, and others red, and all sorts of other colours; and then, smearing the wall with plaster and sketching on it a man and a plant he proceeded to fix some of the counters in the outline of the face, some in that of the hands and some in that of other parts; and thus he completed the outline of the man he had imaged by a number of counters equal in number to the units which he said defined man." And as soon as number had

been thus exalted as the source of physical reality, it took possession of the spiritual universe ; one, because unchangeable, was reason ; two, because variable and indeterminate, opinion ; three or five because a union of odd and even, marriage ; four or nine, because square numbers and suggesting an eye for an eye, justice ; eight, because the harmonious octave, love and friendship ; and so on *ad nauseam*. Abstractions—as ever in uncritical minds—issued forth from the depths of human consciousness to become for their makers full-blooded realities.

Later Pythagoreanism (13) was cast in a different mould. Its distinctive features were, first, a practical acknowledgment of the force of Zeno's dialectics and, secondly, an attempt to assimilate the then current theory of the four elements. Pythagoreans of the time of Socrates held that things were like numbers, not that they were numbers. Moreover, they accepted in a sense the theory of the four elements : this acceptance meant the rejection of the older view of the Unlimited as air. But, like Plato, they denied that the four elements were ultimate : they seem to have held that these elements were made up of particles which had the shapes of the five regular solids—thereby apparently interpreting the Unlimited as an extended body. And since Zeno had proved that lines cannot be constructed out of points, they admitted that the actual triangles, out of which the four elements were ultimately made, were not triangular numbers, but likenesses of these numbers.

HERACLEITUS.

The philosophy of Heracleitus (fl. 504 B.C.) is dominated by the thought of the continuous change going on in the world : nothing remains what it is ; everything passes into something else ; and that something else is called by Heracleitus its opposite. This means not only that all individual existences are transitory but also that the matter composing any individual is never altogether the same for two consecutive moments of time. Plato (14) is explicit : " nothing ever is, everything is becoming ; all things are in motion like streams ; all things are passing and nothing abides." " Heracleitus says somewhere that all things pass and naught abides ; and, comparing things to the current of a river, he says that you cannot step twice into the same stream." Aristotle is equally clear : " all things are in motion ; nothing steadfastly is." And though the phrase " all things are flowing " is not found in any of the fragments of Heracleitus, everyone of his fragments emphasise the transitoriness both of man and of nature : any real thing, however stable in appearance, is merely a section in an ever-flowing stream and the stuff composing it is never the same at any two consecutive moments.

Flux rules the life of man : waking or sleeping, youth and age, life and death. " Man is kindled and put out like a light in the night-time." (15) " And it is the same thing in us that is quick and dead, awake and asleep, young and old ; the former are

shifted and become the latter, and the latter in turn are shifted and become the former." (16) "Upon the same stream we do and we do not embark for we are and we are not." (17) This Flux never ceases: from life death and from death life through food; from youth age through lapse of years and from age youth through procreation; from waking sleep and from sleep wakefulness. It rules also in nature: night follows day, day night; winter follows summer, summer winter. "The sun is born afresh every morning" (18) and dies every night: clouds change into rain—"water lives the death of air"; rivers form at their mouths alluvial deposits—"earth lives the death of water." (19) "You cannot step twice into the same river, for fresh waters are ever flowing in upon you." (20) This way of regarding man and nature make it necessary for Heracleitus to seek out a new primal substance. He needed a world-stuff of such a nature that it would be always passing into everything else while everything else would be returning into it. Fire seemed to satisfy these requirements. A steady flame appears to retain its identity although its contents are continually coming and going: it seems to have a fixed thinghood because what is passing away as smoke is being always replaced by fuel. It is also likely that the ancient belief in fire as the source of life influenced Heracleitus: a belief based on the warmth of living bodies and the stiffening of corpses, the vivifying influences of summer and the deadening effects of winter. "This world," he writes, "which is the same for all, no one of gods or men has made; but it was ever, is now, and ever shall be an ever-living Fire, with measures kindling and with measures going out." "It (fire) is the thunderbolt that steers the course of all things." (21)

The universe is, therefore, a huge fire that burns incessantly: the world of nature—as well as we who contemplate it—is in a state of perpetual flux. Nothing is at rest: every apparently permanent being is changing; at every moment, some matter is passing out of and other matter is coming into the structure of all beings. The ceaseless movements of fire bring about these untiring changes of things: fire assumes through qualitative change a different form in each thing, bringing into existence the multitudes of individuals, urging them forward to their own destruction, and thus introducing ever new forms of being only to return ultimately to fire. "All things are exchanged for Fire and Fire for all things just as wares for gold and gold for wares." (22) This exchange follows a regular path (23): fire becomes water and water earth; earth liquifies into water, and from water are derived all other things by evaporation, and ultimately fire. Fire, water, earth constitute what Heracleitus calls the downward path; earth, water, fire the upward path. (24) At any given moment, each of these three forms of matter is made up of two equal portions, one of which is pursuing the upward path and the other the downward (25): for instance, half the sea is for ever taking the downward path and has just been

fiery storm-cloud, and the other half has just been earth and is pursuing the upward path; when rain falls, a proportionate part of the sea turns into earth; when the sea evaporates, a proportionate part of the earth turns into water. The same is true of man.[26] He is made up of fire, water and earth; the fire—which alone is conscious—is perpetually becoming water and the water earth; but, as the opposite process goes on simultaneously, man like a candle flame appears to remain the same. "The soul is fully alive only when awake; sleep is a stage between life and death. Waking and life are due to warmth and fire: the dry soul is the wisest and the best." [27] "Sleep and death are due to the advance of moisture: the drunkard is led about by a beardless boy, not knowing whither he goes, for his soul is wet; it is death to souls to become water." [28]

The simultaneity of the upward and downward paths is the secret of the apparent stability both of things and of men and of the whole universe. Moreover, the fact that the two halves of everything are being drawn in different directions explains the underlying order of the universe: the accuracy of the arrow is due to the opposite tension of the hands to each other and to the different parts of the bow; the sweet note of the lyre is due to an analogous tension and retention. "Men do not know how what is at variance agrees with itself: it is an attunement of opposite tension like that of the bow and lyre." [29] "It is the opposite which is good for us." [30] "Man is the father of all and the king of all; and some he had made gods and some men, and some bond and some free." [31] "Homer was wrong in saying: Would that strife might perish from among gods and men. He did not see that he was praying for the destruction of the universe; for if his prayer was heard, all things would pass away." [32] The upward and downward path are two inseparable halves of one and the same world process: if either were to cease, the other would cease also; what explains the one explains the other. "The way up and the way down is one and the same." [33] Thus does the fire-flame figure, to the mind of Heracleitus, those deeper subtly disguised currents of universal change that are ever stealthily withdrawing the apparently solid earth itself from beneath our feet. Despite his childish analogies and his paradoxical explanations, this Greek divines that doctrine of flux which is the burden of Hegel and Darwin and Kelvin: mind and life and matter make an ever-flowing stream which knows no rest. Modern evolutionism has, however, no fulcrum: the system in which all things live is for many moderns in ceaseless movement nowhither. Not so, Heracleitus: the way upward and the downward path is not merely a circle; at the upper end, where both paths meet, he puts that pure fire which is not differentiated into parts, Zeus.[34]

The one permanent reality in this endless cycles of change is the all-embracing law that governs them. Nothing remains what it was as regards its ingredients: there is ceaseless loss and

ceaseless gain. "This world was ever, is now, and ever shall be an everliving Fire with measures kindling and measures going out."[35] But "the sun will not transgress his measures: were he to do so, the Erinyes, abettors of Justice, would overtake him."[36] Accordingly, the truly permanent reality in the universe is fixity in the rate of exchange between the various substances: the advancing and retreating streams of matter in each substance proceed in definite directions and in definite proportions. There is no caprice, no arbitrariness: everywhere, a uniform rule holds sway over the endless currents of change. But this fixed law of exchanges admits, as facts show, of alternate variations. Sleep is caused by the encroachment of those dark exhalations from the water in the body which cause fire-consciousness to burn low: wakefulness is restored each morning by an equal advance of the bright exhalation. Again, when either fire or water gains the upper hand, death ensues. It is death to souls to become water: hence the folly of such pleasures as drunkenness or wantonness.[37] Excessive fire also causes death: the heroic death which makes a man a god.[38] But whether men die the fiery or the watery death, their souls begin once more the unceasing upward and downward paths: "gods are mortals, men are immortals, each living in the other's death, each dying in the other's life."[39] Day and night, summer and winter involve similar variations in the fixed measures of Nature's changes. Night is caused by the rise of darkness from the earth and sea: a moist darkness that so increases the watery element as to put out the sun's light. Darkness, however, can no longer rise upwards when the sun is extinct: accordingly, a fresh sun can kindle and nourish itself at the expense of the moist element. But this fresh sun burns up the bright vapour and thus digs its own grave. Thus the sun is born afresh every morning and dies every night: for it is nothing but a mass of burning vapour kindled at sunrise by the dry vapours of earth and sea, burning up and consuming those ascending vapours in its motion by day through the heavens, and paying the penalty of extinction at sunset owing to dark exhalations from earth and sea. The alternation of summer and winter arises from similar causes: the sun's retreat southwards is due to the gradual advance of the moist element caused by the very heat of the sun: its return northwards is but the search for that nourishment which, owing to diminished evaporation, fails it in the south. But oscillate as they will, neither fire nor water can wholly prevail: "so long as things are as they are, fire and water will always be and neither will ever fail."[40]

Another feature of Heracleitean philosophy has aroused so much interest in modern times as to call for special reference.[41] A number of extant fragments assert in the most emphatic manner the identity of various things which are usually regarded as opposites: God is day and night, winter and summer, war and peace, surfeit and hunger; day and night are one; the way up

and the way down are one and the same; good and evil are one; mortals are immortals and immortals are mortals; it is the same thing in us that is living and dead, awake and asleep, young and old; what is at variance agrees with itself, couples are things whole and things not whole, what is drawn together and what is drawn asunder, the harmonious and the discordant. These are the most startling expressions of a thought that pervades certain fragments of Heracleitus: the thought, namely, that each thing is a unity of opposites. What exactly Heracleitus meant by this correlation of opposites has been long and vigorously disputed. Aristotle (42) in certain passages condemns such utterances as a denial of the principle of contradiction; Hegel,(43) on the other hand, welcomes them as the first historical admission of the identity of being and non-being. It is more consonant with Heracleitus's position as thinker to regard both the Aristotelian censure and the Hegelian praise as undeserved: Heracleitus never dreamt of maintaining that opposite qualities belong to the same subject at the same time and under the same respect. The unity of opposites in the concrete is a totally different doctrine from that unity in the abstract; and the former doctrine alone is asserted in fragments of Heracleitus. His fundamental teaching is that the ever-living fire ceaselessly passes into all things, assuming in each of them different qualities, producing in this way particular individuals, and yet finally returning into itself: accordingly, each thing becomes what it is only through the perpetual emergence of the opposites between which it stands. His varied expressions of the coincidence of contraries are but aspects of this central doctrine. There are, first of all, the obvious consequences of a theory of perpetual flux: day is not night, summer is not winter, strife is not peace, good is not evil, but these and all similar contrasts are inseparable halves of that restless process which is the life of the world: were either to cease, so would the other, and with them the universe. Then, there are single beings which are kept in equilibrium by the tension of antagonistic qualities and conflicting principles: man, for instance, is a compost of fire and earth and water. Most intelligible of all are those fragments that speak of a thing displaying opposite qualities when brought into relationship with different bodies: sea-water is good for fish, bad for men; straw is worthless for men, precious for asses; gold precious for men, worthless for asses; bitter vetches a joy to oxen, a disgust to men; the wisest of men an ape compared to God, just as the most beautiful ape is ugly compared to man; and so on. Equally intelligible are other fragments which speak of a coincidence of opposites in two or more agents that produce a single effect: high and low must unite for concord, male and female for procreation. The Heracleitean unity of opposites is, therefore, purely relative. And as we have already noted, this relativity disappears at that upper end where the two paths meet: men

think this right and that wrong, but to God all things are fair and good and right.

Nb Such is the outline of the Heracleitean theory of the universe: fire the world-element, flux the world-process, definite sequence and equivalence the world-law. Heracleitus believed that he had got rid in this way of all permanent reality—the one invariant in all these changes being the all-embracing law; the universe is at once One and Many—the opposite tension of the Many constituting the unity of the One. And though he did little for the scientific and methodical discovery of the causes which bring about change, his insistence on the fact of perpetual flux in our world gave a definite bent to the speculations of his successors. After his day, the character of pre-Aristotelian Cosmology changes: the problem of the stuff out of which all things were made yields place to the somewhat different problem of the agencies that produce all things. And a first reply, developed at least contemporaneously, was that of the Eleatics: the denial of the very possibility of such production.

The Eleatics.

"I hold thee back . . . from that course also, upon which mortals knowing naught wander two-faced; for helplessness guides the wandering thought in their breasts, so that they are borne along stupified like men deaf and blind. Undiscerning crowds, in whose eyes it is, and it is not, the same and not the same, and all things travel in opposite directions." (44) This panting invective is hurled at Heracleitus by Parmenides (fl. 474 B.C.). He had been in his youth of the school of Pythagoras and had brought thence a vehement conviction of the power of thought. Accordingly his solution of the problem concerning the nature of things turns on the answer to the question—what is thinkable? His predecessors had taken for granted that one or other primal substance could assume different forms. How was this possible? Anaximenes had suggested by rarefaction and condensation. Whether rarefaction and condensation implied in the mind of Anaximenes particles and interstices, we do not know. But they certainly did imply both in the mind of Parmenides. And when his Pythagorean teachers spoke of the world as inhaling empty space or air from the boundless mass outside it and spoke of this empty space or air as entering into the world to separate the units, the problem of the possibility of empty space became a pressing one. Now the whole strength of the Parmenidean theory lies in its denial of the possibility of empty space whether within or without our world. And his one proof runs: empty space is nothing and nothing is unthinkable; only that which can be thought can be.(45) He proceeds, then, to unfold in a thorough-going fashion the consequences of this starting-point.(46) What-is can never have come into existence: for it could come only from nothing and there is no such thing

as nothing.[47] What-is can never pass out of existence: for it could only pass into nothing and nothing does not exist. What-is is unchangeable, for every kind of change involves a transition from nothing to something. What-is is unique: for there is no empty space in which anything else beside itself could come into existence. What-is is continuous and indivisible: for there is nowhere anything else distinct from itself by which its parts might be divided. What-is is homogeneous: for were it not at all points equally perfect there would be somewhere a streak of nothingness. What-is is, therefore, a continuous, undivisible *plenum:* the body or matter of popular language provided we remember that, at this stage of Greek thought, matter had not been distinguished from life and mind. This continuous indivisible *plenum* is, for Parmenides, finite: hemmed in by the real on every side and no empty space outside it. It is spherical; for it is equally real in all directions. In short, this Parmenidean world may be pictured as a uniform, unchangeable, limited whole, without parts, without beginning, without end, resembling the bulk of a well-rounded and equally weighted ball: a finite sphere, at once spiritual and material, always and everywhere identical with itself; but a sphere of matter that is sterile because immovable and a sphere of spirit that is powerless because inactive. It is true that our senses attest a world of multiplicity and of motion: a world of birth, and decay, and death. So much the worse for our senses, retorts Parmenides. Sense appearances are illusions: thought alone is trustworthy; and thought tells us that a world of multiplicity and motion is an utter impossibility.[48] Thus did this first Eleatic make a clean sweep of the Many—all these things and persons that press so closely on eye and ear and heart at every moment; and establish in their place the rigid, inalterable, One.

Naturally this denial of so ubiquitous, so tyrannical, so irresistible a fact as the world of experience sent a peal of laughter ringing through Greece. But Zeno (fl. 449 B.C.) would not see his master vanquished with a grin: turning on the scoffers, he paid them, as Plato says, "to the full in their own coin and added not a little." His pithy dialectics fill but a single page of Aristotle or Simplicius: yet so compact are they with difficulties that they have puzzled generation after generation of thinkers. His method is to take one of his adversary's fundamental postulates and deduce from it two contradictory conclusions: and thus he tries to show that assumptions like multiplicity and motion lead to even greater absurdities than the theory of Parmenides. Four of his famous arguments are directed against multiplicity. If there[49] were a plurality of bodies each of these bodies would be at once infinitely large and infinitely small; infinitely large, because each body can exist at all only if it has magnitude and this magnitude implies extended parts outside extended parts and other extended parts between these parts to infinity; infinitely small, because the ultimate parts of these bodies can be true units

only if they be indivisible, unextended realities and no multiplication of such units can result in magnitude. If there [50] were a multiplicity of bodies, these bodies would form simultaneously a finite number and an infinite multitude: a finite number, because there are so many of them, no more and no less; an infinite multitude, because two things are two only when separated by a third and this separation in turn involves something between the third and each of them and so on to infinity. If there [51] were a multiplicity of bodies, there would be an infinity of spaces because, everything real being in space, space itself unless it lacks reality must be in another space, this secondary space in a tertiary space and so on to infinity. If a bushel [52] of corn were made up of thousands of separate grains, each of these grains, when let fall singly to the ground, ought to make a noise, because otherwise how explain that great noise caused by the fall of the bushel as a whole; and yet—each ought not to make a noise because our ears testify that a single grain when falling separately sinks noiselessly to the ground. More famous still are Zeno's paradoxes concerning motion.[53] The first is the impossibility of ever reaching the end of a racecourse: a body can move to the end of any distance only by first traversing half that distance; but to traverse half that distance, it must traverse half of that half, and so on; motion involves, therefore, the transition of an infinite number of points in a finite time. His second paradox is the impossibility of Achilles overtaking a tortoise: if Achilles gives the tortoise a start, then, before he reaches its starting-point, it will have got a little way-on and the same thing repeats itself with regard to this little way-on to infinity. The next paradox refers to the flying arrow at rest: if the arrow measures one foot in length and is launched at the rate of ten feet a second, then, it occupies a space equal to its own length in every tenth part of that period of time; but the sum of an infinite number of positions of rest cannot constitute motion. His last paradox is that the motion theory makes half the time equal to double the time: if three bodies exist, one lying at rest and the other two of equal length moving past it with equal velocity in opposite directions, then one of these moving bodies will pass in the same time twice the number of points in the other moving body that it passes in the body at rest; therefore, the time it takes to pass the moving body is twice as long as the time it takes to pass the body at rest; but the time which both moving bodies take to reach the position of the body at rest is the same; therefore double the time is equal to the half.

Zeno was followed by Melissus (fl. 441 B.C.), the systematiser of this school. His arguments for the indestructibility, imperishability, and immutability, of the barren static One are but so many paraphrases of those set forth by Parmenides. Earth and water, air and iron, gold and fire, the living and the dead, black and white—all these, and what men say currently of such things, are mere names and sense illusions. He departs from his

master's teaching on the question of the finite size of the One : (54) what is temporarily infinite must be spatially infinite ; moreover, were the One limited, it should be limited by empty space. Lastly, he is remarkable for a forecast that is destined apparently to immortality : " if there were many things, they would have to be just of the same nature as the One." (55) In this sentence, Melissus heralded unwittingly the exit of Eleaticism and the advent of Atomism. A conclusion intended by him as the *reductio ad absurdum* of pluralism was accepted afterwards as the foundation-stone of their system by Leucippus and Democritus.

EMPEDOCLES.

Empedocles (fl. 472 B.C.) concedes to Parmenides that being can neither begin to be nor cease to be. " Fools ! (56) for they have no far-reaching thoughts who deem that what before was not comes into being, or that aught can perish and be utterly destroyed : for it cannot happen that aught can arise from what-in-no-way-is ; and it is impossible and unheard of that what-is should perish for it will always be wherever one may keep putting it." He grants also the impossibility of empty space : " in the All there is naught empty." (57) He insists, however, on the reality of change : the senses assure us that particular things come into, and pass out of, existence. And he reconciles his concessions to Parmenides with his trust in sense experience by postulating a plurality of everlasting substances : the birth and death of particular things are but the spatial union and disunion of these qualitatively unchangeable realities. " Hear, first, the four roots of all things : shining Zeus, life-bringing Hera, Aidoneus and Nestis whose tear-drops are a well-spring to mortals " (58) ; fire, air,(59) earth (60) and water are the underived, irreducible, imperishable roots of all existing substances. Why exactly Empedocles chose these four as roots is not certain : he may have taken them over eclectically from his predecessors or he may have regarded the different states of aggregation as the fundamental essence of all things. Whatever was the reason for his choice, he explains all individual existence as a mixture of these roots. " But when the elements have been mingled in the fashion of a man and come to the light of day, or in the fashion of the race of wild beasts of plants or birds, then men say that these come into being ; and when they are separated, men call that woeful death. They call it not aright ; but I too follow the custom and call it so myself." (61) Whence this power of uniting and of separating in the roots ? Here, Empedocles sides once more with Parmenides against Heracleitus and the Milesians : there is no impulse towards movement in the roots themselves. Accordingly, he sets up in addition to the four roots two principles of motion which he styles Love and Strife : Love for union, Strife for separation.(62) These principles are, despite their names, spatial and corporeal, somewhat akin to the " fluids " of early

nineteenth-century science. Love is said to be "equal in length and breadth" [62] to the four roots; Strife is described as equal to each of them "in weight." [62] Love and Strife are equally powerful. Conflict is ever being waged between them, and each in turn gradually drives out the other. At the beginning, the roots are mixed together in a single sphere, an echo of Parmenideism: Love is triumphant, Strife powerless. But no sooner has Love completely ousted Strife than this latter begins once more to enter the sphere and to grow strong there. A period ensues during which Love is passing out and Strife coming in: all this time, the roots are partially separated and partially united. This period ends with the victory of Strife: triumphant Strife completely separates the roots into conglomerate masses of similars. Then, Love begins once more to regain the mastery: it gradually reverses the victory of Strife and in time binds up the roots again in a single sphere. These cycles recur perpetually, each of them with its four periods: complete inter-mixture, transition from this to separation, complete separation, return to unity. A world of change like ours can exist only in the second and fourth of these periods: these periods when both Love and Strife are in the world are the eras of births and deaths. "There is a double becoming of perishable things and a double passing away. The coming together of all things brings one generation into being and destroys it: the other grows up and is scattered as things become divided." [62] But these two principles of Love and Strife explain only one aspect of the problem: that of the moving cause. The question of the nature of mingling and separating remains. Empedocles answers here that the four roots are qualitatively changeless; that effluxes stream off from all bodies [63]; that the roots run through one another [64]; that all differences between things are due to different proportions in the mixture; that just as painters by mixing only four pigments in a variety of proportions can produce likenesses of all things, similarly nature by skilful mixture of the four roots produces countless multitudes of perishable creatures.[65] The possibility of mixture, then, in the theory of Empedocles, depends on the existence of particles which can lie side by side in the compounds. And Aristotle says that Empedocles explained mixture by the "symmetry of the pores." [66] Mixture would seem, therefore, to be effected by the entrance of the particles of one body into the pores of another: the pores of some bodies are symmetrical and these can mingle easily—hence the attraction of like for like; on the other hand, a fine body will run through a coarse body without becoming mixed and a coarse body will not be able to enter into the pores of a finer one; in short, all combinations are not possible—"water fits better into wine, but it will not mingle with oil." [67] Thus, for Empedocles, bodies are a group of particles which have openings between them: their mingling and unmingling are reduced to the coming and going of material particles which remain eternally changeless in quality; and the

distinctive qualities of the mixture, differing as they may and do from the qualities of the roots, are due to the varying proportions of their constituents.

Anaxagoras.

Anaxagoras (fl. 460 B.C.) sought another way of reconciling the Eleatic doctrine of unchangeable substance with the facts of sense experience. He accepts the arguments of Empedocles against absolute becoming and qualitative change. "The Greeks follow a wrong usage in speaking of coming into and passing out of existence: nothing comes into and passes out of existence; but there is union and separation of the things that are. The right usage would be to speak of coming into existence as mixture and of passing away as separation." (68) He agrees with Empedocles also in denying the existence of empty space.(69) But he rejects his predecessor's solution of the origin of particular substances. "We use a simple nourishment when we eat the fruit of Demeter or drink water: but how can hair come from what is not hair, or flesh from what is not flesh"? (70) His own theory seems to have been thought out along the following lines. Bread nourishes our bodies. Bodies are made up of parts that have distinctive qualities: skin, flesh, bone, blood, hair, etc. Now since change of quality is unthinkable, these qualitatively distinct parts could never have found their way into human bodies unless they were already present in the bread; and for the same reason, this richness of qualitative distinction must have been present in corn and in the nourishment of corn—earth, water, air, solar fire. The four roots are, then, most complex: storehouses of countless qualitative particles. Moreover, what is true of man is true of every animal, every bird, every plant, every mineral. The qualitative parts of everyone of these, and of everything else that ever did or shall exist, must have been extant from all eternity: otherwise, at some moment, qualitative change would have happened. The primal constituents of matter, therefore, are as numerous in number as the least shades of difference perceptible to our senses and as the multitudinously varied combinations of qualities displayed by any material substance. In short, the original substances are unlimited both in kind and in number: that is the tremendous conclusion drawn by Anaxagoras from the premiss that birth and death are merely the union and the separation of pre-existent parts. In the beginning, these countless qualitative articles were mixed so thoroughly and so minutely that no single quality was individually perceptible: that mixture, as a whole, displayed none of the distinctive qualities of things. "All things were together infinite both in number and in smallness": "seeds of all things with all sorts of shapes and colours and savours." (71) And he seems to have held that all possible qualities were simultaneously in the smallest particles of that mixture: "everything is in everything." (72) Still, even in that first mixture, air and æther prevailed over all other things: for

they were greatest both in quantity and in size, and, even though everything is in everything, each thing has the appearance of those things of which it has most.

The starting-point of our world, then, is an infinite multitude of innumerable seeds divided into infinitely small parts. This composite medley of qualities lasted until *Nous* intervened and set up a process of continuous differentiation which gradually formed our present world. This *Nous* is primarily a cause of motion. And Anaxagoras was driven to postulate this external cause by his acceptance of the Eleatic teaching that matter of itself cannot move. Aristotle thinks that our author discovered this world-forming force from experience of the power of mind in human conduct. And he praises him for introducing mind as the cause of all order in the world: "Anaxagoras spoke like a sober man in contrast with the random speech of his predecessors." (73) It is difficult, however, to make out what exactly was meant by *Nous*. The most bewildering characteristics are assigned (74) to it. It is certainly distinct from all other substances: it is infinite and self-ruled; it is mixed with nothing, for, were it mixed with any it should be mixed with all, and, then, it would have power over nothing; it is omniscient and omnipotent for only through such knowledge and power can it arrange and move, as it does, all things for the best. These characteristics suggest that Anaxagoras meant by *Nous* an incorporeal being like human reason but with far greater powers. There are other characteristics, however, that suggest a subtle kind of matter, an impersonal force: *Nous* is the thinnest and purest of all things; it has greater and smaller parts. Its action, too, is purely mechanical: it imparts to a portion of the original matter a rotatory motion which gradually extends over a wider and wider space. Hence the disappointment of Plato and Aristotle with *Nous*: "Anaxagoras uses mind as a *deus ex machina* to account for the formation of the world; and whenever he is at a loss to explain why anything necessarily is, he drags it in." (75)

Anaxagoras seems at first sight to be face to face with insuperable difficulties in explaining birth and death and change in the world of experience. For there, no less than in the original mixture, everything is in everything. But if that be so, how can one thing even apparently emerge from another? His reply is that what at any stage comes into being was in reality already there, but that at one particular moment it becomes so prominent as to be perceptible. Dark water comes from white snow: the dark particles were always present in the snow; but they were invisible up to the melting stage owing to the prevalence of white particles. "All things have a bit of everything"; "the things that are in the world are neither divided nor cut off from one another with a hatchet." (76) "Nothing, however, is like anything else, but each single thing is most manifestly those things of which it has most." (77) Anaxagoras ventures a

greater paradox: "and in all things many things are contained and an equal number both in the greater and the smaller of the things that are separated off." (78) No extant fragment clears up this paradox: but a comparison of two fragments excludes both of two obvious explanations. The smaller could contain a less number than the greater on one or other of two hypotheses: decrease in size might result in a quality reaching its smallest possible dimensions so that any further diminution would involve its disappearance; increase in size might result in such extension that all stuffs of a particular kind would be absorbed by this enlarged object so that none of it could remain over for any other body. Anaxagoras explicitly rejects both of these hypotheses: "nor is there a least of what is small, but there is always a smaller"; "there is also always something greater than what is great." (79) However great or small, then, a body is, it contains a portion of everything and there are as many portions in the smallest particle as in the greatest. And if any particular object appears to us to contain some one quality to the exclusion of others, this happens only because that object contains more of that than of those other qualities: as a matter of fact, each thing contains qualities of every kind but it gets its name from that special quality of which it has most.

Such was the world-theory of Anaxagoras: the universe is made up of an infinite multitude of seeds which develop from chaos into cosmos owing to a vortex motion that is started by an initial fillip given to one portion of its mass by *Nous*.

THE ATOMISTS.

Empedocles and Anaxagoras prepared the way for the most important pre-Aristotelian theory of the constituents of bodies, Atomism. Leucippus (fl. 450 B.C.) laid the foundations of this theory, but Democritus (b. 460 B.C.) completed the superstructure with such gifts of erudition and style that it is only nowadays the true significance of his teacher is being realised.(80) Aristotle who paid Atomism the tribute of his keenest attention and criticism gives a clear account of its origin.(81) It arose, he tells us, out of that denial of the void by means of which the Eleatics sought to prove the impossibility of motion and multiplicity. Parmenides and his school had argued: Motion and multiplicity are impossible without empty space; but there is no empty space; therefore there is no motion, no multiplicity. The Atomists retorted: Motion and multiplicity are impossible without empty space; but there is motion and there is multiplicity; therefore, there is empty space. Atomists granted, indeed, that empty space was not real in the Eleatic sense of being corporeal: they insisted, however, that it existed. Since motion was a fact, empty space cannot be identified with the non-existent: "what-is-not" in the Eleatic corporealistic meaning "is" in another meaning just as much as "what-is." And,

in addition to empty space, there was body or the Full. But if the facts of experience are to be accounted for, this body cannot be interpreted as the Eleatic One: it must be broken up into an infinite number of parts that are separated from one another by the void. Zeno had proved that absolute division would abolish magnitudes: consequently, this division of matter must stop at indivisible particles, atoms. Atoms are indivisible, not mathematically, but physically: and they contain within themselves no empty space. Once an infinite extent of empty space and an infinite number of atoms are secured, the Atomists accept and transfer to these atoms all the properties of the Eleatic One. Atoms are increate and imperishable: whence could they come? whither could they go? They are subject to no internal changes: not from within for they have no parts that admit of displacement; not from without for they have no empty spaces. They are all of the same nature for they all act on one another.(82) But this changelessness and this homogeneousness refer only to quality: quantitatively, the atoms are infinitely various.(83) They differ in shape—and this includes size—position and arrangement: A and N; A and ⊳; AN and NA. Moreover, these quantitative differences must be infinite in number: otherwise, the atoms and their groupings could not explain the infinite differences and changes of things in our universe. Only one condition governs this infinity of differences: all atoms are too small to be perceived by our senses.

These presuppositions account for everything that happens in our universe: all properties and all changes in bodies are due to the number, shape, size, position, and arrangement of the atoms of which these bodies consist. Birth is a union of atoms; death a separation of atoms; growth an addition of atoms; decay a subtraction of atoms; qualitative alteration a change either in number, shape, size, position, or arrangement of atoms. All reciprocal action between bodies is a push or a pull of atoms: there is no action at a distance. The physical properties of bodies are explained mechanically by the quantitative relations of these atoms. Some properties belong to the bodies themselves: for instance heaviness, lightness, hardness, softness. The weight of an atom depends on its size: the weight of a body depends on the amount of atomic matter it contains; bodies of equal size may enclose more or less empty interspaces and thus differ in weight. Hardness and softness are similarly conditioned by the proportions of emptiness and fulness within a body: and even when the number and the size of empty interspaces are equal in two bodies, one of them may be harder than the other owing to the manner in which these empty interspaces are distributed. Other physical properties such as temperatures, colours, and tastes are really sensations caused in us by the number, shape, size, position, and arrangement of a body's atoms: one and the same body will evoke different sensations according as it touches our senses with atoms of such and such numbers, shapes,

sizes, in such and such a position, arranged in closer or looser, equal or unequal order.

Thus does the assumption of empty space enable the Atomists to shatter into an infinite number of fragments the world-sphere of Parmenides and to scatter these fragments through the infinite immensities of space. Atoms and the void furnish the raw material of our universe: particles of matter, solid, indivisible, impenetrable, eternal, unchangeable, indestructible, infinite in number, so small as to be invisible, exactly alike in nature, differing only in shape and size and position; surrounded on all sides by empty interstices as by a network of canals, constantly impinging on one another and uniting into groups, yet communicating with one another solely by external contact and collision. These invisible, extended, homogeneous indivisibles moving about in empty space, are the only existing realities: all qualitative differences between things are illusions of sense-perception. "In truth, there are atoms and a void: by convention there are a sweet and a bitter, a hot and a cold, and according to convention there is colour." (84) Such was the first European theory of Atomism: in the main a speculation based on Eleatic metaphysics, the physical facts that suggested it being but the trite experiences that things are many and are subject to birth, growth, decay, death.

By atoms and the void, the Atomists explained also the formation of our world and all its contents. The nature and cause of the "eternal motion" of the premundane and extramundane atoms are matters of dispute (85): but whether this original motion be regarded as a confused motion this way and that or as a perpendicular fall due to the weight of the atoms, it results in collisions which set up in an infinite number of places a vortex motion. Now, all atoms are not equally gregarious: some have hooks and eyes, balls and sockets, involuted edges and so on; some have no handles of this kind and can be kept together only if inclosed by others as in a shell. But when in the vortex atoms that are fit for combination meet, they are woven gradually into larger and larger wholes until they form a shell that shuts in multitudes of other atoms: this shell cuts off its contents from the infinite void, and thus serves to enclose the makings of one of the infinite number of existing worlds. Our world is clearly a cosmos: land and sea and heavens; earth at the centre, fire at the circumference. And the Atomists illustrate its development by such analogies as the action of the winnowing fan on grain and of the tide on stones; lentils lie next to lentils, barley to barley, wheat to wheat; long stones are heaped beside long stones, round pebbles beside round pebbles. Vortex motion produces similar results in cosmic processes: it segregates and brings together atoms that are alike in shape and size,—flinging watery particles beside watery, earthy beside earthy, and so on until it forms the four large distributions of water, earth, air and fire. Moreover, in every eddy of wind and water, larger bodies

make their way to the centre and smaller bodies are squeezed out towards the circumference; that is why the large atoms of earth congregate at the centre and the small atoms of fire at the circumference in our world. Thus was the formation of our world and all its contents formulated for the first time in kinetic and materialistic terms; "naught happens by chance, everything by law and necessity." (86)

Plato.

Plato (427-346 B.C.) denies that there can ever be a science—in the true sense—of Cosmology: the world of experience, including matter, belongs to the realm of becoming and is therefore merely a copy of that true reality, the world of Ideas. "And in speaking of the copy and the original we may assume that words are akin to the topic which they describe; when they relate to the lasting, the permanent, and the intelligible, they ought to be lasting and inalterable, and, as far as their nature allows, irrefutable and immutable—nothing less. But when they express only the copy or likeness and not the eternal things themselves, they need only be likely and analogous to the real words. As being is to becoming, so is truth to belief." (87) Every theory of the ultimate constituents of matter deals with what is always becoming and never is, not with what always is and never becomes. Becoming for Plato, however, cannot be an object of scientific knowledge: it is merely an object of belief. "Enough if we adduce (on this question) probabilities as likely as any others . . . we ought to accept the tale which is probable and enquire no further." (87) Plato gathers these probabilities from his predecessors: the perpetual flux of Heracleitus; the four roots of Empedocles; the Unlimited and the Limit of the Pythagoreans; the invisible indivisibles of Leucippus and Democritus. But he fashions these borrowings after a method all his own. He is no mere syncretist: he opposes to that world of perpetual flux, the world of Ideas; he challenges the irreducibility of the four roots; he denies the existence both of atoms and of the void; and though in identifying forms with numbers, he leads his readers through a labyrinth where it is confessedly difficult to find one's way, he himself kept his head sufficiently well throughout all these meanderings to destroy once and for all two insuperable obstacles to the progress of Greek arithmetic and Greek geometry—the hypotheses that the numerical series has the unit as its origin and that the point was a unit having position.

The fountain-head of all Platonism is the theory of Ideas. For our present purpose, it is sufficient to recall that the world of Ideas is a superphysical world of eternal and immutable types: that the objects of scientific definition and scientific truth are these unchanging forms; and that the objects of sense experience are merely approximate and imperfect copies of these types or forms, and get from them their class-names. The Ideas, then,

are the only true existents: sensible objects are but a shadow, a mimicry, a copy of these Ideas. And that is why there can be no science of Cosmology: its subject is sensible matter and sensible matter is not, for Plato, a full-blown reality.

Let us see, however, what Plato thinks we may *believe* about the ultimate constituents of sensible matter. Part of his treatment of this problem consists in a deductive proof of the existence of the four elements and an empirical proof of their reducibility. That deductive proof [88] runs. What is created is of necessity visible and tangible: visible and therefore made of fire; tangible and therefore made of earth. But in order that fire and earth be combined into a unity such as our world, there must be a proportional mean between them; solids are always connected by two middle terms. Accordingly, God added to earth and fire the two other elements air and water. His empirical proof of the reducibility of four elements is set forth in the following [89] words. "We speak of fire and the rest of them . . . and we maintain them to be the first principles and letters or elements of the whole although they cannot reasonably be compared by a man of any sense even to syllables or first compounds. . . . In the first place, we see that . . . water, by condensation, I suppose, becomes stone and earth; and this same element, when melted and dispersed passes into vapour and air. Air again, when inflamed, becomes fire, and again fire, when condensed and extinguished, passes once more into the form of air; and once more, air when collected and condensed, produces cloud and mist, and from these, when still more compressed, comes flowing water, and from water comes earth and stones once more; and thus generation appears to be transmitted from one to the other in a circle." This empirical proof of the reducibility of the four elements, which was later used by Aristotle as the basis of Hylemorphism, is used by Plato chiefly for the purpose of refuting Empedocles.

Plato's own theory of matter grows out of his theory of Ideas rather than out of the empirical facts of the transmutation of the elements. He sets up on the one side that world of Ideas—the prototype, the truly existent, the immutable, the self-dependent, the one: and on the other, the world of sensible objects—the copies, the non-existent, the mutable, the mutually-dependent, the many. Then, the problem is: how can imperfection issue from perfection, becoming from being, manifoldness from unity? His solution is that a special principle, the direct contrary of the Idea, must be assumed as the basis of all sensible existence: a principle which is the cause of non-being, of change, of dependence, of divisibility. The fullest description is given in the *Timæus.* There this principle is called the receptacle, and in a manner the nurse of all generation; the universal nature which receives all things and never assumes a form like any of those things which enter into her; the invisible and formless being which receives all things and, in some incomprehensible way,

partakes of the intelligible; the formless receiving principle which may be likened to a mother, the impressible mass which is to receive, perpetually and throughout its whole extent, the copies of all eternal beings, and for that reason must be devoid of any particular form.(90) Plato's hearers use similar terms when speaking of this Universal Recipient. Aristotle says that Plato in his lectures reduced matter to the Unlimited, the Great and Small—that is, to an indefinite continuum which is capable of increase or decrease to any extent: and again, that this Great and Small was identified with non-being, which implies, not that the indefinite continuum of the more or less was nothing, but that it was not anything.(91) What, then, did Plato mean by this Universal Recipient? Aristotle answers,(92) space of three dimensions: and some of our best modern scholars (93) agree with the Stagyrite. Plato's text is their proof. In several consecutive paragraphs of the *Timæus*,(94) he describes rather fully the triad of principles that are necessary to account for our world. In the first of these paragraphs:—a pattern, intelligible and always the same; the imitation of the pattern, generated and visible; the receptacle, and, in a way, the nurse of all generation. In the following paragraphs:—that of which the thing generated is a resemblance, the source or fountain-head likened to a father; that which is in process of generation, the intermediary nature likened to a child; that within which generation takes place, the receiving principle likened to a mother. Farther on:—one kind of being which is always the same, uncreated, and indestructible, and the contemplation of which is granted only to intelligence; another nature of the same name as this, like it but created, becoming, vanishing, and apprehended by opinion and sense; a third nature which is space and is eternal and indestructible, and provides a home for all created things, a nature apprehended not by sense but by a kind of spurious reason. And having concluded this description, Plato adds: "Thus have I given concisely the result of my thoughts; and my verdict is that these three, being and space, and generation, existed in their three ways before the heaven."

This conclusion regarding the identity of the Universal Recipient with space is confirmed by Plato's mathematical construction of the four elements. There is no mention of a corporeal stuff that assumes figured shapes. Bodies are formed simply by throwing certain portions of space into the shape of the four elements: as is clear, from the assertion that they are compounded out of and resolved into planes. How and what planes thus form the four elements is detailed at great length.(95) Plato's guiding principle is the discovery of the four most beautiful figures, which are unlike one another and which are capable—in some instances—of resolution into one another. He selects on these grounds the isosceles triangle, and that form of the scalene which has the square of the longer side three times as great as the square of the lesser: "out of these, fire and the other elements have been

constructed." By combining triangles of these kinds and of an infinite variety of sizes, we get certain geometrical forms: from the scalene are formed the three first regular solids—the tetrahedron, the octahedron, the icosahedron; from the isosceles is formed the cube. These geometrical forms are, in their turn, identified with the four elements: the cube as the most immovable and the most plastic is identified with earth; the tetrahedron, as the most movable, with fire; the octahedron, as intermediary, with air; the icosahedron, as after the cube the least movable, with water. This mathematical construction of the elements furnishes in its turn the key to their transformations and their motions. Three of the elements are interchangeable because composed of similar triangles. That transformation consists in their resolution into their original triangles, and a reunion of these latter in new ways: a particle of water, when decomposed, gives two particles of air and one of fire because the twenty triangles of an icosahedron can form, when rearranged, two octahedrons and one tetrahedron; a particle of air, when decomposed, gives two particles of fire because the eight triangles of an octahedron can form, when rearranged, two tetrahedrons. Earth, however, has triangles peculiar to itself: it cannot, then, be changed into any of the other elements; it can only be dissolved into its original triangles.

This transformation and this dissolution (96) depend on the distribution of the elements in space. Here, Plato postulates a theory of natural places: fire, earth, air and water have, each of them, a particular region in our universe assigned to them and, of themselves, congregate there in large masses. The motion of the external orbit of the universe acts as a check on this natural tendency of each element to gather into one spot: that orbit is circular and continuous and exerts, by its revolution, sufficient pressure on the things within it to thrust the four elements out of their natural places. The result is incessant mixture of the various kinds of bodies: the smaller bodies being crowded into the interstices of the larger. And when the smaller quantities of one element are caught thus by larger quantities of another, the smaller must either escape or decompose: they may escape to their natural place; failing that, if they are portions of fire or air or water they are changed into the larger element, if they are portions of earth they are dissolved into their constituent triangles. Thus is brought about and maintained a perpetual process of circulation of the four elements: the circulation that in its myriad intricacies makes up the motions and the changes of the material universe.

Plato's theory of the ultimate constituents of matter may be characterised in modern speech as mechanical: he regards all sensible differences between bodies as consequences of more ultimate differences in geometrical structure. Space is ever the same, taking on with complete indifference the forms that pass in and out of it. These forms—copies of the Ideas—are the

primordial triangles and their products, the regular solids. These regular solids are the four elements: these elements congregate in large masses at their natural places; three of them are transformable into one another; the fourth is merely decomposable. There is a universal attraction of the smaller masses of each element to the larger masses of its kind: like to like. There is no void: particles of matter are ever pushing one another round and round. Such are the outlines of a Platonic mechanism which rivals the doctrine on which in certain moods Plato expends his finest irony—the Atomism of Leucippus and Democritus.

The Pythagorean [97] features of Platonism have ever proved a mass of seething controversies: controversies fraught with significance for the system as a whole. But the references to the problem of the constituents of matter scattered through these developments, whether found in the writings of Plato or of his disciples, are mere asides that throw no new light on the doctrines of the *Timæus*. Plato in the *Republic*, the *Sophist*, the *Parmenides*, refers to matter as non-being; in the *Philebus*, as the Unlimited; in his oral lectures—according to Aristotle, Hermodorus, Eudemus—as the Unlimited, the Great and Small, non-being, the source of evil. When examined in their contexts, however, these technical phrases do not provide any sufficient reason for abandoning or supplementing Plato's mathematical analysis of the corporeal into geometrically fashioned shapes of space. The expressions are, it is true, Pythagorean: but so far as our present problem is concerned, there is no fundamental change of thought: the doctrines are those of the *Timæus* once more.

CHAPTER II.

ARISTOTLE'S CRITICISM OF THE COSMOLOGY OF HIS PREDECESSORS.

Aristotle's criticism of the cosmological theories of his predecessors is based on his theory of causality.(1) He holds that, when you ask yourself why such and such a state of things exists in the universe, four partial answers may be given and each of these corresponds to a cause. Consequently, a complete theory of the causality of matter requires the enumeration of all four. This view of causality was developed apparently from observation of the making of artificial products and of the biological processes of reproduction and growth. A coalvase is constructed out of copper; copper is its material cause; it has a special shape or structure which marks it off from all other articles made out of the same metal—this structural shape is its formal cause; it gets this shape from the artificer—he is the efficient cause; it was made for the purpose of holding coals or of wage-earning or of fame—coalholding, wages, fame are its final causes. An oak starts from a particular kind of germ, an acorn—the acorn is its material cause; it develops perfections characteristic of an oak and not of a plane or ash—these perfections are its formal cause; the acorn itself did not come from nothing, it was produced by another oak—that parent oak and its acorn-bearing activity are its efficient cause; the whole process of growth leads up to a final stage, in which the whole perfection that was, at the beginning, present in the efficient cause is fully realised in the material cause—the adult oak is the final cause of the acorn.

Aristotle on the Milesians.

Aristotle (384-322 b.c.) rejects without much ado the solutions of the Milesians; "it is clear that all who regard the universe as one and assume a single entity as its material—and that a bodily and extended entity—have fallen into error in several respects."(2) These errors may be summed up under two heads. One main objection is that the Milesians do not treat of all kinds of causes; they treat of only one kind of cause, the material cause—hence they give no constituent principles for incorporeal beings; they neglect the agency by means of which change is produced—the efficient cause; they do not assume the

essence as the cause of anything that happens—the formal cause; they do not treat of the goodness or beauty of things—the final cause. A second difficulty is their arbitrary choice of particular bodies as primal world-stuff: they call anyone of the four simple bodies, except earth, a principle without advertence to their reciprocal generation from one another: from the point of view of generation, the most elementary ought to be that body which is finest in texture and has the minutest points—fire; from the point of view of the logical superiority of the completed result of development, water should be prior to air and earth to water; lastly, substances so definite in nature as water and air exclude many physical qualities by reason of the opposition of their own qualities to those of other substances, and, consequently, it is impossible to derive those other substance from either of them without much more machinery than was dreamt of by the Milesians. As for that boundless mass of Anaximander, Aristotle is not very definite about its nature, probably because no clear statement concerning it was uttered by Anaximander.(3) He is content to urge against the latter's theory that spatial infinity is not essential for the incessant production of new things; and that "separation" was a word whose meaning was left altogether vague. His general criticism, if expressed, would likely have been that the qualitative distinctions of actually existing substances could not be derived from that which has no definite qualities by means of Anaximander's meagre principles.

Aristotle on the Pythagoreans.

Aristotle urges against the Pythagoreans that their principles are better suited to objects of mathematical study than to sensible bodies.(4) First of all, their philosophy of nature excludes all possibility of those motions which are the source of all natural processes: they do not tell us how there can be motion; or how, without motion, there can be generation and destruction; or how, without motion, the stars can traverse the heavens as they do. Neither do they explain how the first unit was constructed so as to possess magnitude; and what can they mean by asserting that, when the first unit had been constructed, the nearest part of the Unlimited began to be constrained by the Limit. And even if it were granted or proved that spatial magnitude is made out of the Limit and the Unlimited, how could this method of structure account for the existence of bodies, heavy and light? and how are the remaining qualities of bodies —temperature, taste, colour—to be derived from numbers? "Number is neither the cause as agent, nor the matter, nor the ratio and form of things." (5) Number is not the essence "for the ratio is the essence while the number is the matter: for instance, the essence of flesh or bone is number only in this way, 'three parts of fire and two of earth.' And a number, whatever

it is, is always a number of certain things, either of fire or earth or of units but the essence is that there is so much of one thing to so much of another in the mixture; and this is no longer a number, but a ratio of mixture of numbers whether these are corporeal or of any other kind." (6) "Nor, of course, is number the final cause": "what good do things get from the fact that their composition is expressible as number? . . . In fact honey-water . . . would do more good if it were in no particular ratio but well diluted than if it were numerically expressible but strong." In short "these people are like the old Homeric scholars, who see small resemblances but overlook great ones." (7) They tell us nothing about the objects of experience—fire, earth, and the rest—because their principles are in no way adapted to the explanation of these objects. Their definitions are superficial: they regard anything to which a term under examination is first applied as the essential nature of the object in question—"as if one were to think that 'double of' and 'the number 2' are the same thing on the ground that two is the first number which is the double of another." (8) And the attempt to accommodate their theory to facts results in the most glaring inconsistencies: for instance, they explain material and immaterial realities by one and the same number (9): opportunity because it is seven is in one special part of the world and a body which is seven is also in that same part of the world; accordingly, the question arises whether we are to distinguish these sevens because of the differences between the objects symbolised or whether we are to deny the differences between those objects because of the identity of their numbers. Again (10) they invent bodies to suit their caprice: the number 10 is thought by them to be perfect and to comprise the whole nature of numbers; accordingly, they insist that ten bodies move through the heavens, and since only nine are visible they invent the tenth—the counter-earth.

Aristotle on Heracleitus.

Aristotle urges against Heracleitus a total disregard of the incorporeal, and an insufficient explanation of the corporeal. The theory of Heracleitus is applicable at best only to corporeal substances whereas there exist also incorporeal things. Even with reference to corporeal things, Heracleitus made several mistakes. He did not proceed in an intelligible way in his selection of a primary body: for he did not discuss the mode of production of other bodies from this primary body: nor did he weigh the bearing of the respective values, in processes of development, of the temporal starting-point and the completed result. Again, however irrefragable it be, that there is underlying the production of anything, something out of which the product—be it one thing or several—is formed, that truth is only one aspect of the problem: there still remain unanswered other aspects—

that of the efficient cause, that of the causal influence of the thing's essence, and that of the final cause. So far Aristotle does but treat Heracleitus as a thinker of the Milesian type.(11) He has, however, special difficulties against the theory of flux.(12) His first complaint is that Heracleitus does not say explicitly what is the nature of that change to which all things are ceaselessly subject. He proceeds, then, to prove that no change whether of substance or of size or of place can go on uninterruptedly; that, as the changeable portion of our world is but a fraction of the whole, it would have been more just to acquit that part because of the other than to condemn the other because of it; that, even when a thing is not constant in quantity, its quality or form—that through which we know each thing—remains; finally, and most trenchantly, that, if a thing perishes, there will be present still some thing that persists and that, if a thing comes into existence, there must be something from which it springs and something by which it is generated.

Aristotle's attitude to the Heracleitean unity of opposites is vacillating. He has too much good faith to misrepresent an opponent on the strength of these paradoxical utterances, and too much intelligence to accept the most startling fragments in their context as the verdict of a logician. Hence, a series of cautious criticisms: some think Heracleitus says that the same thing can be and not be—but a man need not believe all he says (13); again, Heracleitus adopted, without understanding what he said, this opinion of the identity of opposites—if questioned, he could be forced to confess that opposite statements can never be simultaneously true of the same thing.(14) But Aristotle's good faith and intelligence were often hard driven by an inveterate habit of stating and criticizing, from his own standpoint, the views of his opponents: and elsewhere, when speaking on this point, he flings to the winds all hesitancy and declares the unity of opposites to be in conflict with the principle of contradiction —" the doctrine of Heracleitus that all things are and are not, seems to make everything true." (15)

Aristotle on the Eleatics.

Aristotle contests the principles, the arguments, and the conclusions of the Eleatics. Their first principles (16) are vitiated by obscurities both of language and of thought: the different meanings of their favourite concepts—being and unity—are never distinguished; even if being had only one meaning, the unity of all being could not be proved; the finiteness of Parmenides and the infinity of Melissus imply a denial of the unconditional unity of being—in fact, every proposition about being involves a distinction between thing and quality; being is but a common predicate of all things, and accordingly " what-is-not " or " non-being " is perfectly thinkable as the denial of some

definite kind of reality; they attack the divisibility of being, and yet describe it as extended in space. Then, their arguments are as faulty as their principles. Each member of the school in disproving the possibility of change overlooks the only tenable hypothesis [17]: that whatever comes into existence springs not from absolute nothingness, but from something which relatively to the finished product is nothing. The polemics of Zeno in favour of his master are futile.[18] Three of the eight arguments hardly need refutation: one grain of corn does make a noise when falling singly but this noise is so slight as to pass unnoticed by our ears: the space in which each body exists is nothing else than the surface or surfaces of surrounding bodies, and each of those surfaces exists in its own body as substrate; the paradox of equalising the half and the double is due to the fallacy that the space traversed by one body ought to be measured according to the size of another body, which it passes, whether that other be in motion or at rest. The other five arguments are more puzzling: the alleged consequences of contradictory magnitudes, and contradictory numbers, on the supposition of pluralism; the alleged consequences of the unfinished racecourse, the unbeatable tortoise, and the ever-resting flying arrow, on the supposition of motion. Aristotle allows that these paradoxes follow logically from Zeno's presuppositions about continuous quantities. His contention is that in every instance these presuppositions are false. Were a continuous body really divisible into an actually infinite multitude of parts, it would be infinitely large and infinitely small, and its number of parts would be simultaneously finite and infinite. That supposition can never be realised because it is impossible to come to the end of the division of a continuous body: the number of parts obtained by actual division, however protracted, is always finite; the size of each part decreases proportionately with the number of parts made, and thus the sum of their extension remains always the same; moreover, there exists no actual distinction of parts at all in a continuum prior to actual division; in short, infinite divisibility and infinite quantity are two totally different things. Again, a finite distance in space is not composed of an infinite multitude of successive and separate units: nor is a finite lapse of time composed of an infinite multitude of successive and separate moments. Hence the question can never arise of traversing an infinite number of spatial units in a finite time. Both space and time are continuous magnitudes that are endlessly divisible; and if anyone makes a difficulty of the possible endless subdivisions of space, his opponent may fairly rebut it by recalling the possible endless subdivisions of time. But, as a matter of fact, finite spaces and finite times exist, prior to division, as continua without any distinction of parts: consequently, there are no insuperable difficulties of a theoretical nature, either about traversing any particular distance or about traversing such a distance at different speeds or about traversing

it in a finite lapse of time. Then, the plea of Melissus [19] in favour of infinite space is unsound : why should infinity in space follow from infinity in time ? and how could the real be spatially indeterminate ? But the general conclusion of the Eleatic School is the worst of all their many paradoxes. The alleged nullity of the world of experience is but a cloak for their failure as a school to solve the most pressing problem of philosophy [20] : if, closing our eyes to the differences of things, we allow that the Eleatics and their despised opponents whether among the masses or the philosophers, as well as all the curious and complicated processes at work in living beings on the earth and in the heavens, are all one and the same, do we not assert the identity of opposites? or, if the hills and cities of Greece and that humanity which they house, with its busy, brilliant, fretful life, are all non-existent, what, then, can claim to be existent ?

Aristotle on Empedocles.

Aristotle argues that the denial of change, whether substantial or accidental, by Empedocles contradicts our experience : the four elements are mutually transformable, and the same elements unite in true mixture to form unitary compound substances ; bodies, while remaining the same kind of substance, suffer changes of quality and quantity—colour, taste, size, etc.[21] He suggests also that the sphere of Empedocles compels an admission of real generation : if the elements are in it completely united, their qualitative differences must disappear—and, accordingly, the subsequent emergence of the elements involves their coming into existence out of a homogeneous substance. Passing to details, Aristotle raises sundry difficulties concerning the elements and their motive forces.[22] These elements are chosen at haphazard—no compelling reason is advanced for their acceptance ; their number is not accounted for—why should they be no more and no fewer than four ? their equality is not clearly defined—is it an equality of magnitude or of power ? their qualities do not explain such distinctive characteristics as lightness and heaviness ; the doctrine of pores and effluences leads logically to empty spaces and atoms—though Empedocles accepts neither the one nor the other ; the pores are not accurately described—if empty, what of the denial of the void, if full what is their use ? Similarly, the principles of motion are not well thought out [23] ; according to Empedocles, Love unites and Strife separates, but, in the system itself, Love also separates and Strife also unites ; their mode of action is more or less fortuitous ; finally, why, in a world like ours, should their simultaneous operation be preceded by complete mixture, and followed by complete separation ?

Aristotle on Anaxagoras.

Aristotle repeats in his criticism of Anaxagoras the chief objection to the theory of Empedocles : the absurdity of denying qualitative changes in our world. Then he marshals a number of difficulties [24] against the special tenets of Anaxagoras. An infinite number of primary bodies is needless, for a small number would do equally well ; it is false, for the fundamental distinctions of kinds are numerically limited ; it is fatal, for knowledge of the infinite is impossible. Plants and animals have a definite natural size : consequently their constituents—seed, hair, flesh, bone, etc.—cannot be indefinitely big and small. Again, if exhaustive secretion is possible, everything is not in everything—there is no flesh in the residual water : if it is impossible on the grounds that more always remains behind, then, you are bound to admit the absurdity of an infinite multitude of finite magnitudes in a finite body. Moreover, no explanation is forthcoming in this theory of Anaxagoras of the differences in weight between bodies. And despite his denial of empty space, the doctrine of an infinite number of constituent parts imperils the continuity of bodies. Finally, the original chaos is brimful of paradoxes : things would have to exist first in an unmixed state ; nature does not allow any chance thing to be mixed with any chance thing ; specific qualities would be separable from their respective substances ; motion in the original chaos subsequent to infinitely continued rest would contradict the regular order of nature. It is true that Anaxagoras surpassed his predecessors in setting up Mind as the purposive cause of the world's beauty and order : he uses it, however, merely as a stop-gap and drops it whenever he can in favour of mechanical causation.[25]

Aristotle on the Atomists.

Aristotle regards Atomism as the most important doctrine of matter among his predecessors : " no one before Democritus paid much attention to the processes of bodies, but he seems to have thought out everything about these processes." [26] He rejects, however, on the grounds of experience all the leading theses of the Atomists : empty space, the existence of atoms, the homogeneity of matter, the denial of qualitative change, the exclusion from nature of finality.

Democritus had accepted empty space as the only possible explanation of local motion, of rarefaction and condensation, of growth, and of the experimental fact that a vessel filled with ashes holds as much water as one that is empty. Aristotle retorts [27] that motion in a *plenum* is possible if bodies interchange places ; that condensation is explicable by extrusion—compressed water yields up the air it previously had ; that rarefaction admits of one or other of two explanations—in some

instances, it is due to the entrance of fresh matter into bodies, in others, as when water passes into steam, it is due to a change in substance which necessitates a change of volume ; that growth is explained by change of substance ; that the conclusion drawn from the experiment mentioned may be explained away as due partly to the inaccuracy of the supposed fact and partly to extrusion of the enclosed air. Having thus rebutted the arguments of his opponents, Aristotle proceeds to prove that empty space would make motion impossible : no characteristic motion of bodies can occur in empty space for it admits neither of up or down or middle : the flight of projectiles could not occur in empty space—there would be nothing to maintain and direct their motion, and there would be no reason why they should come to rest here rather than there since the void yields equally on all sides ; bodies of equal masses ought to fall or rise with infinite rapidity because of the infinite rarity of the void, and bodies of unequal masses ought to rise and fall with equal rapidity because of the lack of resistance of the void—conclusions which Aristotle believed to be contradicted by facts. (28) For these and cognate reasons, Aristotle concludes slyly that those who think out this theory of empty space can see for themselves "there is really nothing in it." (29)

Aristotle multiplies *ad nauseam* difficulties against the atoms.(30) He argues that atoms cannot be indivisible—for the division of extended matter could reach a limit only if the continuum consisted of mathematical indivisibles ; that atoms, even if they existed, need not be infinite in number and shape—firstly, because all known differences of kinds and qualities and positions and motions are reducible to a few fundamental types, and secondly, because the finite or determinate is preferable to the infinite or indeterminate, a characteristically Greek argument ; that atoms which act on one another merely by pressure or collision could not, even with the help of fantastic hooks and eyes, constitute a cohesive body ; that the atoms, for instance, of water and air can not have a distinctively fixed shape since these substances readily adjust themselves to vessels of every shape ; that no reason can be assigned why there should not be large as well as small atoms ; that if the atoms are homogeneous, they should, when brought into contact, join together into one body—just as water unites with water ; that if the atoms are heterogeneous, this heterogeneity of stuff, and not their differences of shape, must be the cause of phenomena ; that if qualities like warmth, coldness, hardness, softness, weight, are coupled with definite shapes, atoms necessarily influence one another and cease to be unchangeable ; that, on the one hand, atoms cannot be without qualities—possessing, for instance, merely shape—for body is tangible, and what is tangible must be qualitative ; that, on the other hand, atoms cannot have qualities—for if each has only one quality, this coldness, and that hardness, they are not homogeneous, whereas if each has several qualities, the same indivisible

thing will be simultaneously hot and cold, soft and hard, active and passive; that if the atoms are moved by an extrinsic cause, they are passible; that if the atoms are moved from within themselves, then they are either divisible into parts which are motor and moved, or one and the same thing is at once motor and moved; that if the elementary atoms are distinguished from one another only by their size, one element could not be developed from another; that if the atoms cannot interact, empty space will not suffice to set bodies interacting, for these interstices merely bring atoms into contact.

Aristotle's chief difficulty against homogeneity of matter is the obvious differences of bodies as regards weight: sparks fly upwards, stones fall; in water, large logs of timber float, tiny lumps of lead sink.(31) The atomistic explanation of lightness was based on empty space: the greater the interstices, the lighter the body—fire was the lightest of all bodies, for it contained most void: still, the lighter body must contain not only more void but also less full—otherwise a large lump of gold with big empty spaces would be lighter than a small mass of fire. Aristotle points out the worthlessness of this explanation: according to it, the absolutely heavy must be that which has most full or that which has least void. Neither definition fits the facts: there are surely sufficiently large masses of fire that enclose more full than tiny clods of earth, and there are surely tiny masses of fire that contain less void than large lumps of earth; and yet fire, large or small, ascends while earth, large or small, descends. Nor does the supplementary suggestion, based on the relative proportions in bodies of the full and the void, meet this difficulty. Great and small masses of fire must contain relatively the same proportions of full and void, and so, too, must great and small lumps of lead: and yet, the greater the mass of fire the more quickly it ascends, and the larger the lump of lead the more quickly it falls. Finally, it is absurd to hold that bodies rise because of the enclosed void unless it be of the nature of the void to ascend; and if the void of itself ascends, the full of itself must fall. And should that be so, the problem of the differences in weight between bodies is merely transferred from these bodies to their alleged constituents: there, it meets us in all its difficulty once more. Why does the void ascend? Why does the full fall? And how is it that the void and the full do not exist, wholly apart, in separate regions of space?

Aristotle insists also upon the reality of qualitative changes in bodies: changes of substance in generation and destruction, changes of qualities in alteration, changes of size in growth and decline.(32) Atomists admitted only changes of spatial position, and attempted to reduce all other kinds of change to this: generation and destruction were the union and the separation of atoms; growth and decay, the addition and subtraction of atoms; alteration, spatial redistribution as regards order and position and number of atoms; in Aristotle's words, the most

contrary things were said by the Atomists to be constructed out of the same atoms somewhat as tragedies and comedies can be constructed by transposition of the same set of letters. In this connection, the trump card of atomism was its suggestion that bodies enter into and influence one another through the pores: it certainly gained popular sympathy for their theory because, to the thoughtless, once indivisibles are invisibly entangled in one another everything seems possible. Aristotle stresses from the start the weakness of this appeal to the pores: if atoms are incapable of influencing one another reciprocally when they come into contact, pores cannot relieve this incapacity for pores merely facilitate contact. His strong point, however, on this problem of change is experience; the four elements come into and pass out of existence; true mixtures are formed by the union of the four elements; some bodies completely absorb others; substances often gain new qualities and lose pre-existing ones. Consider, first of all, the births and deaths of the four elements: earth becomes fire; fire becomes water; water becomes air; air becomes water; water becomes earth. How are these facts explicable on the atomic hypothesis? The elements cannot be formed from elementary atoms that differ merely in size, for, then, how could their distinctive sets of qualities arise; nor from an incorporeal substance for a similar reason; nor from a body different from the elements themselves, for this body could have neither weight nor natural location, and, accordingly, could not exist in space. The only remaining solutions are development from one another either by substantial generation or by extrusion. Extrusion would mean, for instance, that when air is formed by evaporation from water, a group of atoms hitherto imprisoned in the water would emanate therefrom: how can one accept this view who knows that water can be so completely resolved into air as to leave behind no insoluble residuum? and then, there is the other equally adverse fact that the evaporated air occupies so much larger a space than the original water that unless allowed to escape it will burst the containing vessel. Hence the only satisfactory solution of these facts of experience is the admission of substantial generation: water with its distinctive qualities ceases to exist and air with its distinctive qualities begins to exist. This same solution is needed for other mutual transformations of the elements, for difficulties somewhat similar in character block the way of explaining the changes that occur as cases of extrusion: when fire becomes water, and water earth, in both instances bodies which are heavier than their sources come into existence; when earth becomes fire, there is an enormous increase in volume; and when earth becomes water, this must mean on the atomic view that some atoms are extracted from the earth—but if such extraction can go on forever, there must be an infinite number of particles in a finite body. Substantial generation occurs also in cases of absorption and of the formation of true mixtures. Absorption is the

complete conversion of one body into another: the merging of a drop of wine in a hundred gallons of water, and the changing of food into living flesh. True mixture is the formation of a new substance from the union of the four elements: the living tissues of plants and animals were the examples best known to Aristotle. And by arguments similar in kind to those urged in favour of the transmutation of the elements, he proved that neither absorption nor true mixture is a mere mechanical juxtaposition of elementary atoms: in the light of the characteristics of weight and touch and activities, which mark off flesh and bone from every kind of food, who can really believe that grass and bread and meat are merely inset in plants and animals like bricks in a chimney stack? Nor is alteration merely so much spatial change among the parts of a substance; when water freezes and ice melts, the whole substance changes from liquid to solid and back again from solid to liquid, and the consequent changes in volume are due neither to a coming together nor to dividing off of particles, for the continuum is everywhere equally solid or equally liquid. The alterations of living bodies are still more inexplicable on the atomistic hypothesis, for they—to quote Aristotle's illustration—change from health to sickness, from non-musical to musical, from ignorance to knowledge. Again, growth is not a mere addition of new parts to those already there, nor decay a mere subtraction of old parts: the one implies the increase, the other the decrease of the preexistent as a quantitative unit. Accordingly Aristotle concludes that the evidence at our disposal is overwhelmingly in favour of qualitative changes both in substances and in accidents. Nature is not a collection of comedies and tragedies cunningly contrived out of the spatial transpositions of an alphabet infinitely homogeneous in quality.

Finally the Atomists (33) had explained everything that happens in the heavens and on the earth as due to the fortuitous collision of material antecedents: rain falls because the clouds cool and thicken, and not at all in view of the ripening of corn, as is clear from the fact that, later on, this same rain rots the corn; when teeth are formed, some incisive, others molar, and thus adapted to their respective functions, that result is also due to the fortuitous concurrence of various circumstances; in short, all things happen fortuitously, but those of them that are lucky hits, in the sense of being able to triumph over their foes from within and from without, live on and perpetuate their kind. Aristotle thinks this account of natural processes incorrect. "Democritus, however, neglecting the final cause reduces to necessity all the operations of Nature. Now they are necessary, it is true, but yet they are for a final cause, for the sake of what is best in each case. Thus nothing prevents teeth from being formed and shed in this way; but it is not on account of these causes but on account of the end; these are causes only in the sense of being the moving and efficient instruments and the material. So is it reasonable that Nature should perform most of her operations using breath

as an instrument, for as some instruments serve many uses in the arts—the hammer and the anvil, for instance, in the smith's art—so does breath in the living things formed by Nature. But to think that necessity is the only cause is as if we should think that the water has been drawn off from a dropsical patient on on account of the lancet, not on account of health for the sake of which the lancet made the incision." (34) And against the Atomists, Aristotle holds that everything in nature works for a fixed goal. He supports this view mainly by four arguments (35): nature is overwhelmingly regular in its processes, and what happens always or even usually cannot be assigned to fortuitous concurrences; wherever you discover a series of changes always leading up to some last stage you think of those changes as directed toward it as product—now, the heavenly processes recur in strict order and with unbroken regularity, and all living beings periodically reproduce their kind; art either perfects or imitates nature, and art always aims at some end—therefore, nature aims at ends; the natural instincts of ants and bees are obviously helpful to them and theirs, and the same fact is evidenced by close study of the tendencies of plants—but ants and bees and plants are the products of nature. This Aristotelian theory of finality is neither extrinsic nor anthropomorphic: it means simply that the natural activities of bodies—their constant modes of acting—are not governed wholly by fortuitous external contacts and collisions but partly, and indeed principally, by determining internal principles: bodies, whether living or non-living, are directed by their respective internal qualities to definite ends. In every case this definite end is the development of "form": its results vary, however, according as we are dealing with accidental processes that take place in an existing substance or with those processes that lead to the production of a new substance.(36) In the first case, the activities of the individual act for its own good—bringing it, as far as circumstances permit, by stages of progress from imperfection to perfection, its essential type remaining unchanged throughout the process: thus, anyone of the four elements when produced seeks its natural place; a true mixture, even after formation, gradually "digests" its contrary qualities and extrudes all excess; the germ of plant or animal advances step by step to maturity. In the other case, the new individual comes from a progenitor of similar species—man begets man, for everything in the universe is arranged for the conservation and perpetuation of species: all natural activities are just what they ought to be to secure for each existing species its regular development in cycles that comprise myriads of individuals. And this immanent teleology within each species, whether living or non-living, accounts for the general order of the universe (37): that unity in multiplicity which manifests itself in the equilibrium and immortality of the universe as a whole, is but the grandiose result of that unity in multiplicity which governs the activities of individuals within each particular

species: in short, it is simply the regular recurrence of the general phenomena of nature. The whole conserves itself through the multitudinous activities of parts, that possess an independent individuality, and yet are, in relation to that whole, mostly ephemeral realisations of fixed species whose orderly interrelationships permit each and all to be perpetuated. The whole is eternal because of the perennial vitality of its parts: and thus, the destruction of the individual is but the expression of the larger world-teleology.(38)

Aristotle on Plato.

Aristotle rejects Plato's denial of all qualitative variety in matter, and his reduction of all sensible differences between bodies to the number, shape, and size, of their constituent planes. He urges (39) that a theory which maintains that bodies are composed of planes or indivisible surfaces involves the contradiction of indivisible lines; that since lines are constructed with points, Plato's view resolves solids into points; that since the primary triangles cannot be divided, Plato denies the divisibility of bodies; that Plato's geometrically shaped planes cannot fill all space within our world although their propounder rejects empty space; that the fact of bodies like air and water assuming the shape of their containing vessels cannot be reconciled with the fixed shapes of their planes; and that as a continuum cannot be formed by composition nor out of planes subject to composition, flesh and bone or any compound body cannot come into existence. In addition to these mathematical objections, Aristotle urges a number of physical ones. Bodies (40) that have weight cannot be constituted out of imponderable surfaces: nor does the explanation of the *Timæus* that the heavier consists of many, the lighter of fewer, constituents of the same kind meet such a fact as the existence of absolutely light and absolutely heavy bodies; and if this explanation were valid with reference to the other two elements, there ought to be large masses of air which are heavier than small masses of water—a conclusion that is contradicted by experience, for the greater the mass of air the more quickly it rises and even tiny particles of air ascend upwards out of water. Further, experience assures us of the mutual transformations of all four elements, whereas Plato's theory compels him to deny this transformation in the case of earth: even in those transformations allowable on Plato's theory, superfluous triangles may be left over owing to inequality in the multitude of constituent triangles; lines may be superimposed on, as well as juxtaposed to, one another and since planes may be put together in the same way, a superimposition of surfaces which would not form either elements or compounds is not excluded by Plato's principles. Fire (41) is said by Plato to be made of pyramids because of its mobility, earth of cubes because of its immobility: but fire will not leave its natural

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place—it ought, then, be a cube there; and earth will strive to escape, and rapidly too, from the regions of fire, air and water —it ought, then, be a pyramid in these regions. Fire is supposed to heat and burn because of its corners: if that be so, the other three elements ought to heat and burn for their constituent triangles have corners. Fire is supposed to change fuel into itself, but pyramids do not change what they touch into pyramids any more than do swords or saws. If heat be united with a particular shape, then its contrary, cold, ought to be united with a contrary shape: shapes, however, have no contraries. For these and similar reasons, Aristotle dismisses Plato's theory of matter as unsatisfactory.(42)

CHAPTER III.

PERTINENT ARISTOTELIAN VIEWS IN NATURAL SCIENCE.

Aristotle's conclusions in those branches of knowledge that are now known as physics, chemistry and astronomy are a necessary prelude to a clear grasp of his philosophy of matter. And as these conclusions are reached by means of the Aristotelian method of scientific proof, it will be useful to begin our present chapter with an outline of this method.

Aristotle's Theory of Scientific Proof.

Aristotle bases his theory of scientific proof (1) upon the fundamental conviction that there exists such a thing as science. By science, moreover, he means something very different from much that has come to be known by that name in modern times. Science was, for him, a system of truths valid always and absolutely for every thinking mind and a system in which the various members are connected by a bond of logical necessity. Another fundamental conviction of Aristotle's was that geometry was a model of what every science should be. An easy approach to the Aristotelian view of science may be got, therefore, by an analysis of geometry. Geometry can be analysed into three constituents. A special class of objects form the subject matter of its inquiries: the initial definitions of the figures about which it reasons. A number of first principles are enunciated as its tools of reasoning: some of these are common to other sciences; some are special to geometry. A number of conclusions are reached by the application of these first principles to the initial definitions: these conclusions are scientifically proved truths. All this analysis is summed up in the significant Aristotelian phrase that geometry starts with essences and proves properties. "Science consists in the knowledge of causes and the cause of a phenomenon is that from which it of necessity arises. Proof, therefore, and apprehension by means of proof are only possible when something is explained from its original causes. Nothing can be the subject of proof except that which is necessary. Proof is a conclusion from necessary principles. That which is ordinarily, though not without exception, true can be included under

matters of proof only in a limited sense. On the other hand, the contingent cannot be proved—cannot even be known scientifically. And since necessary truth is that only which proceeds from the essence and the idea in the subject, while everything else is contingent, so it may be said that all proof relates to and is founded exclusively upon the essential characteristics of things and that the concept of each thing is at once its starting-point and goal. . . . All demonstration hinges on the concept of the thing. Its problem consists of determining, not only the properties which attach to any object by virtue of the conception of it but also of the media by which they are attached to it. Its function is to deduce the particular from the universal, phenomena from their causes." (2)

Aristotelian science involves, then, two main processes: a process of discovery of definitions and first principles: a process of proof of properties by means of these definitions and first principles. This second process, that of proof, need not detain us. Admirers and opponents are agreed that Aristotle both initiated and completed the theory of the scientific syllogism: none of his predecessors had ever done this work; none of his successors has ever succeeded in adding anything of importance to this part of his work. The first process, that of the discovery of definitions and first principles, is the crux of Aristotle's theory of scientific proof. He insists that definitions and first principles are not demonstrable: if they were, demonstration would result in the endless regress. He insists that they cannot be proven necessarily true from the data of sense-perception: the essence of a thing and the necessity of a first principle cannot be grasped by any accumulation of empirical facts. How, then, does Aristotle propose to discover these initial data of all scientific proof? He proffers three suggestions: perfect induction, intellectual intuition, and dialectical reasoning. Perfect induction would prove a proposition to be universally true by showing empirically that it is true in each particular case. This method involves a complete enumeration of individuals and hardly commends itself to a sane man: the best that can be said for Aristotle, in this connexion, is that the example he gives does not start with particular facts at all but with lowest kinds—and these are limited in number and can be cited. Had he recognised no other way of discovering the requisite initial data, his theory of scientific proof would have fallen to pieces. Aristotle was not as big a fool, however, as Francis Bacon and other critics would have us believe. In actual practice, he relied on intellectual intuition and dialectical reasoning rather than on perfect induction. His theory of intellectual intuition was that when a sufficient number of instances of sense-perception have been recorded in our experience, a psychological process occurs in our intellect revealing truths that go beyond these actual facts of sense-experience. This process consists in an infallible intuition by the intellect of the essences of the various kinds, and of the necessity of first

principles. His third source of initial scientific data was dialectical reasoning. Dialectic investigates the definitions and principles of particular sciences by means of principles of universal application. A man whose mind is stocked with principles of universal application has points of vantage from which he may attack or defend the scientific man's claim to lay down special premisses. This dialectical reasoning is a favourite means with Aristotle of testing prevalent opinions: those of the populace and those of the experts. He confronts these opinions with a series of ingenious difficulties based partly on logic and partly on known facts. The consequence is that the opinions in question seldom come through this ordeal without being either wholly exploded or considerably modified. The residue is—in Aristotle's view—a stock of reliable definitions and special principles for the various sciences.

This theory of science and scientific proof has its difficulties. Nowhere in his writings, does Aristotle betray an appreciation of the differences between the subject matter of geometry and that of the empirical sciences; he failed to see or forgot to state that the discovery of essences was not as easy a task in physical and biological science as in geometry. Moreover, dialectical reasoning, consisting mainly, as it does, in answering problems raised by a disputant, tended to inculcate the habit of testing scientific truth by interrogating your opponent rather than by interrogating nature. But the weakness of Aristotle's *theory* need not have led to unsatisfactory discoveries in empirical science. John S. Mill was the first to raise the crucial question regarding the theory of induction: and subsequent thinkers have been very much divided as to the value of Mill's and of one another's solutions. Yet, before and after Mill, modern scientists have been busily doing the work of induction and doing it with ever increasing success: *solvitur ambulando.* Aristotle's theory, then, would not have prevented him from making valuable inductions if he were in practice a careful and untiring observer. This he undoubtedly was. An anthology [3] of extracts, inculcating the most rigid cult of facts and the deepest distrust of mere speculation, might be compiled from his writings. What is far more important, he practised what he preached. He outstripped predecessors and contemporaries by his unwearied patience in research and by his enormous accumulation of facts of observation. Further, this ancient Greek, who busied himself about everything, outstripped, even in their own domain, some of the greatest modern specialists: so remarkable was the accuracy of his studies in biology and so astonishing the extent of his achievements, that Darwin speaks of Cuvier and Linnæus as schoolboys in comparison with the author of the "History of Animals." [4] A similar enthusiasm for facts marks his historical studies. This being so, the question arises how did an observer of this calibre go at times so lamentably astray? His mistakes are as amazing as his discoveries. Side by side with difficult biological details

that have been rediscovered only late in the nineteenth century are catalogued some extraordinary malobservations in biological matters quite easy of access.[5] And everyone knows that Aristotle's long ascendancy over European thought is mainly to be regretted owing to his outlook in Physics, Chemistry and Astronomy. I think we must distinguish between these two sets of mistakes. These rare but atrocious errors in biology may be accounted for by the fact that he collected more facts than he could personally verify: he was too credulous regarding famous authors and popular traditions—who was not until historical criticism, the latest born of the sciences, opened our eyes? This explanation has a partial application, also, to his failure in those other sciences. But another factor intervened here: the lack in Greece of crucial experiments, a lack necessarily consequent on the non-existence of our modern mechanical appliances. It is too often forgotten that the Greeks had little more than their unaided senses, their imagination, and their intellect to aid them in empirical discoveries. Their merits as scientists must be weighed from that point of view. It has been said, for example, that Aristotle foolishly rejected the atomism and copernicanism of some able predecessors. He certainly rejected root and branch the kineticism and the atomism of Democritus. Modern science in the main has approved, albeit unwillingly, of his rejection of thorough-going kineticism: it has never, up to the present, succeeded in reducing all force to motion: and in our day, it has grown careless about this ideal. As for atomism, there is little more than the name in common between the ancient and the modern varieties of atomism: the Democritean atom had all sorts of puerile attachments for grappling its neighbour; moreover, it was supported solely by a series of speculations. Aristotle grappled with these speculations, showed their unsoundness from the standpoint of actual knowledge, and clenched his thesis everywhere by an appeal to the facts of experience. Few readers who recall the actual circumstances of this debate will deny the weight of Aristotle's objections to ancient atomism. The accusation about copernicanism is even more flimsy. The only trace of copernicanism known in Aristotle's time was a suggestion [6] of some Pythagoreans—and possibly of Plato—that the earth was not at the centre of our universe and that it was in motion: but, in the existing state of astronomical knowledge, these suggestions were simply wild guesses. In short, the reader, who keeps steadily in mind the imperfect conditions of scientific investigation amongst Aristotle's predecessors and contemporaries, and weighs impartially the grounds of Aristotle's opposition both to Democritus and these alleged pre-Aristotelian precursors of Copernicus, will be led, I believe, to the conclusion that the Stagyrite missed the path of progress in Physics, Chemistry and Astronomy simply because, in branches of knowledge now ranged under Natural Science, he was the most genuine empiricist

amongst the thinkers of Greece. That conclusion need not blind any reader to Aristotle's one big defect in his handling of the empirical sciences. For, despite a union of talents so eminent and so diverse as to rank him amongst the master-minds of all time both in natural science and in philosophy, there is that in Aristotle which makes the modern gorge rise. It is this. He is not readily content with the observation and enunciation of facts of experience: he is ever anxious to show not merely that these facts exist but also that they follow necessarily from their causes; in one word, he is obsessed with the geometrical ideal of science. And in attempting this task, he often starts from assumptions which are known nowadays to have been the merest conceits, and proceeds to spin lengthy webs of reasoning in order to prove, between a fact and its alleged cause, a bond of logical necessity which is known nowadays to have been a mere figment of his own brain. In instances of this kind where Aristotle is trying to transform a fact of observation into a metaphysical necessity, he is sometimes trapped in the snare against which he warns others: "It is not difficult to set up random hypotheses, to spin them out to great length, and to weave them together." (7)

The Terrestrial and the Celestial Universe.

Aristotle teaches the division of the universe into two essentially distinct parts, sublunary and heavenly, on a variety of grounds: tradition, experience, speculation. Century-old astronomical doctrines of the Egyptians and the Babylonians have attested the imperishable nature and the regular motions of the heavenly bodies: moreover, both Greeks and Barbarians make the heavens the abode of the gods, and believe in its immortal and nobler nature.(8) Our senses support these traditions: they make us aware of the contrast between the immutability and regularity of the heavens and the mutability and irregularity of sublunary bodies and therefore of an impassable chasm between the things of heaven and the things of earth. Aristotle, however, is rarely content with empirical evidence; and accordingly he proceeds to prove that the stuff out of which heavenly bodies are made must be different from that of sublunary bodies. His first argument (9) to that effect is based on an analysis of motion. All natural bodies move in space. Simple motion is of two kinds, rectilinear and circular. There must, then, be two kinds of simple bodies: one to which rectilinear motion is natural; another to which circular motion is natural. Circular motion, he argues, exhibits no contraries: it always returns on itself. Hence the body to which it is natural has no opposites, and is beyond birth and death and change: it cannot begin and it cannot end, for generation and corruption imply opposites; it cannot increase and it cannot decrease, for either implies

more or less of that matter out of which the thing has grown; it cannot in any way alter, for alteration implies either increase or decrease. And since such a body has no rectilinear motion it cannot rise or fall: it is not, then, either heavy or light. A heavenly stuff, therefore, must exist—he calls it æther: a simple, uncompounded, changeless matter which of itself rotates; a something godlike in the realm of body, and therefore fit to be the makings of the heavenly bodies. His second argument [10] toward this conclusion is one of elimination: the heavenly bodies cannot possibly be made of the four elements—fire, earth, air, and water. It is obvious that heavenly bodies are not made of earth or of water. Neither are they made of fire or air: for if the heavens and its contents were constructed out of fire or air, the other elements would long since have been swallowed up by the hugely disproportionate bulk of either; furthermore, there is not enough air in the world to form the azure vault over our heads; even if one imagines all the waters of the world changed to air and all that air in turn to fire, how insignificant would be the volume thus obtained in comparison with the immensities of the heavenly spaces. Once more, then, there must be a special fifth element for the heavenly bodies—æther.

His scientific theory of sublunary bodies is an equally amazing medley of observation and dialectics. Before and after Empedocles, the theory of the four elements—fire, earth, air, water—was popular in the schools of Greece: popular but, as we have seen, not uncontested. It is not easy to explain the origin of this belief. The ancients seemed to have paid great attention to two frequently recurring facts: ordinary combustion and animal decomposition. A stick when burned gives off air and flame, occasionally water, and leaves a residue of ashes: a rotting corpse gives off air gases and turns into dust—while it evidently contains water. Facts of this kind probably prompted the popular view that all sublunary bodies were made up of the four elements. But whatever particular facts first suggested this theory, it owed its subsequent extraordinary longevity to the apparent metaphysical necessity claimed for it by Aristotle. That necessity was grounded firstly on the analysis of motion, and secondly on the analysis of qualities. Circular motion gave him a necessary argument of æther: rectilinear motion gave him a necessary argument for the four elements.[11] Rectilinear motion, he argues, has two directions, up and down: the body which tends naturally downwards is heavy; that which tends naturally upwards is light. This opposition of the heavy and the light is fundamental and qualitative: for reasons already recorded, Aristotle emphatically rejects all attempts to explain weight by quantitative differences of magnitude or shape or density. And on general principles, there must exist two elementary bodies corresponding to these two primitive directions of rectilinear motion—one tending towards the centre, the other away from the centre, of the universe; also, a pair of inter-

mediate bodies, one of which approximates to the former and the other to the latter. In short, earth is absolutely heavy; fire absolutely light; water and air relatively heavy and, therefore, also relatively light. Such is Aristotle's first must-be in favour of the theory of the four elements. His second [12] must-be is based on an analysis of the qualities of matter. All tangible qualities are reducible, he claims, to four fundamental ones, the favourites of ancient Greek philosophy: the hot, the cold, the dry, the moist. Four terms when taken in pairs yield six combinations: *ab*, *ac*, *ad*, *bc*, *bd*, *cd*. Opposites cannot be combined: consequently the hot and the cold, the dry and the moist, are impossible combinations. Hence we have four pairs: and as warmth and cold are active qualities, dryness and moisture passive qualities, each pair of the four has both an active and a passive quality; warm and dry or fire; warm and moist or air; cold and moist or water; cold and dry or earth. But while each element possesses two essential qualities, one is in each instance dominant and characteristic: earth is distinctively dry, water cold, air moist, fire warm.

All four elements act upon and are acted upon by one another through their active and passive qualities: these changes are accidental or substantial. And of the substantial changes the most important are the mutual transformation of one element into the other, and the union of all four to form compound substances. Mutual transformation is more difficult in the case of those elements that exhibit greater qualitative opposition: elements which are but partially opposed in quality are transformable directly; elements which are wholly opposed in quality are transformable only indirectly. The union of the elements in proper proportions gives rise to compound substances: minerals, plants, animals.[13] Every compound substance contains all four. Their habitat proves that they contain earth: earth is not cohesive without water; and since the contrariety of elements is the source of the production of other bodies, compounds that contain earth and water must contain also air and fire. This argument is confirmed as regards living substances by an appeal to the facts of nutrition and decomposition: they feed on and rot away into all four. Thus does Aristotle portray the sublunary world as a self-contained cycle of generation and corruption, the substances of which are incessantly subject to mutual transformation according to definite laws.

The Structure of the Heavens.

Aristotle's astronomy was in the main a reproduction of the teaching of his time: modified here and there by the needs of his personal theories. The guiding principles of the majority of ancient astronomers were, that the earth is at rest in the centre of the universe and, that the heavenly bodies revolve round it

in circles and at a uniform rate. The facts familiar to everyone were sun, moon and stars moving in an azure vault which rises high above our heads and curves down on every side to the horizon. Astronomers studied as intently as their opportunities allowed the contents of this vault: watching them for hours, they saw those in the east rising upwards, those in the south moving westwards, those in the west sinking out of sight; watching them for days, they saw them apparently revolving as on an axis once in twenty-four hours; watching them for years and for centuries, they noticed and recorded that the vast majority of the stars preserved unchanged their relative position in the firmament. How were the motions of the fixed stars explicable? Not by free motions in space of the stars themselves: Newton and Einstein lay centuries and centuries ahead.(14) In Aristotle's time, each star was thought of as set in a sphere. Now, both the azure spheres and the stars appear to move. And their motions cannot be independent of one another for their speed rates correspond with invariable regularity. Perhaps, the stars move and the spheres rest? That cannot be, for, then, the rate of motion of the stars ought to correspond to the size of their circle. Aristotle concludes, therefore, to motionless stars inset in moving spheres.(15) And he finds confirmation of his conclusion in suggestions like these: the stars cannot move because they have no locomotive organs; they could not progress by mere rolling and they do not—as the moon proves—spin; if they did move, their motion through the æther would create a horrible din. All these fixed stars, then, are set like rubies in a hollow sphere of crystal that revolves daily around our motionless earth. But what of those other seven heavenly bodies whose motions seemed to observers hopelessly irregular: Saturn, Jupiter, Mars, Venus, Mercury, Sun, Moon.(16) The sun showed an annual, the moon a monthly, as well as a daily motion: both moved from east to west; and these motions among the stars when combined with their diurnal motions resulted in courses that were spirals, not circles. For all that, both sun and moon moved always forward. Not so the other five wanderers. Mercury, for instance, seems at one time to go forward, at another to go backward, and at another to remain stationary. To square these and like irregularities with the prevalent view of uniform circular motions for heavenly bodies, was the great problem of ancient astronomy. The only solution lay in assigning a plurality of crystal spheres to each of these seven. But how many? Plato proposed the problem to the Academy, and Eudoxos of Cnidos—one of the most eminent astronomers of all time—analysed these non-circular planetary wanderings as resultants of the rotations of twenty-six concentric spheres: three apiece to the sun and moon, and four to each of the five upper planets. The outer sphere of each planet explained its daily revolution in concert with the heaven of the fixed stars; the second, which was fastened into the outer,

revolved in an opposite direction; the others, likewise carried around by their surrounding sphere, but differing in direction and speed of rotation from them, were meant to explain the variations which are observable between the apparent motion of these wandering stars and that produced by the two first spheres; and the lowest or innermost sphere of each planet carries the planet itself. A theory of this kind was bound to undergo ever-increasing elaboration: as observation grew more exact, the discovery of apparent anomalies became more frequent and the demand for a greater number of spheres more urgent. Calippus, for instance, added seven.

Aristotle in refitting this theory of concentric spheres to his own theory of motion added many more.(17) The outstanding features of his theory of motion were: all motion depends on the contact of the moved and the mover; one moving body can produce only one kind of motion in the same matter: every motion proceeds ultimately from an unmoved cause—and when eternal from an eternal cause. He was, in consequence, obliged to assume as many eternal and unmoved movers for the production of spheral motions as there were spheres (18): spiritual beings that bear much the same relation to their respective spheres as the human soul does to the body. Each sphere has a motion of its own that is communicated to it by its spheral spirit: in all cases, this motion is axial, uniform, and eternal; but from sphere to sphere, there are variations of direction and of rapidity. Each inner sphere is so connected with the outer that it is carried round by it just as if its axis were inserted at its poles in this outer one: each sphere, therefore, communicates its own motion to the one next below it. This connection of all the upper spheres with those contained within them is peculiar to Aristotle (19), and forces him to insert additional spheres between the lowest of each planet and the highest of that planet which comes next underneath: otherwise, the motions of the lower planets would be disturbed by those of the higher. These inserted spheres move at the same rate as those they are destined to neutralise but in an exactly opposite direction: twenty of these regressive or retarding spheres were accounted necessary by Aristotle. His heavens (20) consisted, accordingly, of a system of fifty-six concentric spheres, so placed within each other that there is no empty space and so linked together that each without losing its own proper motion partook of that of its enclosing sphere: each of these spheres was of crystal, hollow and transparent, with the result that stars set in the outer spheres were visible through all the inner ones. Of these fifty-six spheres, the first heaven, the heaven of the fixed stars, is the most perfect (21): it is stationed next to the motionless Prime Mover; it accomplishes its purpose by a single motion; it carries round countless hosts of stars; it starts from the better side, and follows the better direction—the right; it moves without beginning, without end, without trouble, and thus rejoices in the most perfect bodily existence. Not so the planetary spheres (22):

many of them are necessary for a single star; they start from the left side; they are not so self-sufficient—carried round and disturbed as they are by their enclosing spheres. All spheres, however, are part of the divine portion of the visible universe [23]: the stars admit neither birth nor death, neither growth nor alteration; they are made of finer stuff than the sublunary elements; and they possess a nature far more godlike than man does; in fact, they are divine bodies, and their spheres are set and kept revolving by gods of the second order.

Interaction of Terrestrial and Celestial Bodies.

All the motions and changes of our sublunary world take place under the influence of the heavenly bodies. It is true that the terrestrial elements by their very nature move in opposite directions, display opposite qualities, act on and are acted on, pass into and mingle with each other. Still this reciprocal causality needs impulse and maintenance from without [24]: everything non-living that is moved is put in motion, and kept in motion by something else. Generation, for instance, arises from heat, corruption from cold.[25] But since cold arises from want of heat, the same explanation accounts for the external conditions of generation and corruption. Heat is due to the swift motions of the heavenly bodies. Not indeed that the spheres and stars get hot: æther is not subject to the law of contrariety.[26] Spheres and stars, however, heat by their movements those layers of air that are nearest to them: just as leaden points melt on an arrow when it speeds through the air. There must be, however, periodicity in this action of the heavens: otherwise, generation would not alternate with corruption. Aristotle traces this periodicity to the oblique motion of the sun.[27] The sun, in advancing through the signs of the zodiac, approaches and warms some parts of the earth, retreats from and leaves cold other parts: thus bringing about nature's birth and growth, decline and death—springs that pass into summers, and through summers and autumns into winters. Aristotle employs those same general principles to explain particular instances of generation and corruption. Changes of warmth and of cold are the most universally active forces in the processes of the four elements.[28] By progressive cooling, fire becomes air and water earth; by progressive heating, earth becomes water and air fire. Those mutual transformations prevent the elements from accumulating in their respective regions: there exists a never-ceasing stream of them, downwards from above and upwards from below.[29] These endless processes, whereby each element passes into all the others and finally returns upon itself, communicates to the sublunary world a sort of infinity of becoming: a perpetuity that mirrors, to Aristotle's mind, the indestructible existences of the heavenly world and helps to bridge the chasm which separates these two parts of our universe.[30]

The Shape of the Universe.

The universe is spherical in shape. It looks so to the eye. It must be so. Aristotle undertakes to show, first of all, that the four elements are grouped in spherical layers, one above the other. The elements uniformly strive to reach their natural places. These places are determined by their distance from the centre of the world. All four must, accordingly, be grouped into spheres which are everywhere equidistant from that centre. In the middle lies earth (31): a solid sphere for the reason just given; and this spheral shape is confirmed by facts of experience—its lunar shadow during eclipses, the differences of the stars visible in the north and in the south, and the fact that bodies falling on the earth move not in parallel lines, but at similar angles. This solid sphere of earth is motionless (31): speculatively, because circular motion is contrary to its essential nature and because the world's rotation needs a fixed centre; empirically, because heavy bodies when thrown upwards in a straight line return to their starting-point and because stars always rise and set in the same place. Water with an upper surface of spheral shape fills the hollows on the earth's crust (32): and as water always accumulates in the deepest parts, it must flow towards the centre until its surface is at all points equidistant. Hollow spheres first of air and then of fire surround those of water and earth.(33) In much the same way, observation and speculation are employed to prove the spheral shape of the celestial regions.(34) Empty space is an absurdity: consequently, the celestial bodies are everywhere in contact with the fiery sphere. The heavens, he argues, look spheral. They must, he adds, be spheral: the sphere is the most perfect figure and is, therefore, the appropriate shape for the noblest bodies; it is also the only figure that can revolve within the space it encloses; finally, it affords the shortest return route in lines that enclose a space and is, therefore, best suited for bodies which, like those in the heavens, move most rapidly.

The Universe as a Whole.

Our universe is the only universe. There is no empty space (35); consequently, there cannot exist other universes separated from ours. The visible sphere of sky which overarches our head is, thus, for Aristotle the limit of the universe. His strong point, here, is the doctrine of natural places: since each element has its own natural place, there can be only one region of earth, of water, of air, of fire, of æther. He dismisses the suggestion that a body may be forcibly detained in a locality beyond the world with the remark that any such locality must be the natural place of some other body: all bodies have their natural places

in this one world of ours and there can be, therefore, no space beyond it.[36] Much subtler depths are foreshadowed in another argument [37] of his that several worlds would presuppose several first causes of motion, specifically similar, materially different: but, there can be no matter in the First Mover. Accordingly, the world that is moved by the single and complete First Cause must itself be single and complete. Here Aristotle has to fight down a spectre of his own—are we ever justified in believing anything unique, ever justified in supposing a "form" realised in only one individual? His reply [38] is that all available matter has been exhausted in the formation of our world: accordingly, its uniqueness is absolutely inviolate; it was, and is, and ever shall be, unique. He appeals, also, to the unicity of the first heaven in favour of the unicity of our world.[39] The unicity of the first heaven is doubly assured: it has the one and only primary circular motion; it has an essence which excludes birth, death, reproduction and, consequently, numerical plurality. But if there can be only one first heaven, there can be only one world, for everything that exists is enclosed within the first heaven.

This unique world of ours is finite, stationary, and eternal. It is finite because it is a sphere: an infinite sphere is impossible; it would have no circumference and, consequently, neither radius nor centre. This finite sphere is stationary. Where could it go? And by what route? There is nothing existing outside it. Again, how could it be displaced—above or below, right or left? All these notions are due to lightness or heaviness: but the first heaven, which encloses and dominates everything else in our universe, is imponderable.[40] Finally, this unique, stationary world is eternal.[41] The heavenly bodies are indefectible: æther cannot change in nature for it has no contrary; æther cannot change in motion for it moves under the essentially immutable influence of the motionless Prime Mover. The heaven has always been, and shall always be, what it is: its eternal youth never wanes. It is true that the sublunary world is a theatre of ceaseless changes: there, death alternates with life, age with youth. But these alternations never had a beginning and never shall have an end [42]: for primordial matter is eternal, and so, also, are the motions of the heavenly bodies—especially those of the sun—which generate and corrupt the inexhaustible potencies of that matter. If it must be allowed, then, that sublunary individuals are mortal, it cannot be denied that their species are immortal.

Such was Aristotle's scientific theory of our universe. The supralunary portion is made of the best material, is utterly changeless, and moves in a perfect way. The sublunary portion is made of inferior material, and given over to birth and death and every kind of change. At the centre of the whole is the motionless earth; around that earth in concentric spherical layers lie water, air, and fire; then come the crystalline spheres

and their inset stars. Everything that happens in the sublunary world is conditioned by the constant motions of these spheres. That motion is imparted to each sphere by an eternal, incorporeal substance—a soul or spirit. But the outermost sphere of all, the first heaven, is moved by the motionless Prime Mover: the deity which is touched but does not touch. Finally, arguing from this view of the contents and interrelations of our world, Aristotle concludes to the unicity, the finiteness, the stationariness, the eternity of the Whole.

CHAPTER IV.

ARISTOTLE'S THEORY OF THE ULTIMATE CONSTITUENTS OF MATTER: HYLEMORPHISM.

Aristotle's method of scientific proof has been already outlined. It consisted in the completion of the method employed by the Pre-Socratics and by Plato ; intellectual intuition and dialectical criticism of the results of methods of observation which were wide rather than deep. We need not expect, then, to meet in Aristotle's attempt to elucidate the philosophy of matter particularly accurate empirical foundations. He was unrivalled in every empirical device that was possible without experiment. But the circumstances of the age in which he worked denied him the means of crucial experiment in physics, chemistry, and astronomy. He excelled, however, in speculative reasoning : and despite the drawbacks occasioned by the impossibility in certain branches of accurate experiment, his philosophy of matter abounds in theoretical considerations of permanent value.

The exposition of his theory of the ultimate constituents of matter centres round the following topics : proof of the possibility of change ; facts and factors of accidental change ; facts and factors of substantial change ; primordial matter ; substantial form ; substance and attribute. Then, I shall close this review of Greek Cosmology by a few words on post-Aristotelian Greek theories of matter.

Proof of the Possibility of Change.

Aristotle prepares the way for his own explanation of change by emphasising two valuable suggestions of his predecessors. He accepts whole-heartedly the principle that nothing can come from nothing : the production of something from absolute nothingness is unthinkable.(1) Next he recalls that second principle, dear to Greek thought, according to which all change takes place between contraries (2) : for some pre-Aristotelians, these contraries were the hot and the cold, the dry and the moist ; for others, the odd and the even, the limit and the unlimited, love and hate ; for others, the thick and the thin, the full and the empty. Aristotle admits a kernel of truth in this second principle : fundamentals are underivable and are the starting-

points of everything else; moreover, the primitive contraries are obviously not derivable from each other or from any antecedent; and lastly, Aristotle's own analysis will show that the terms between which change occurs must be contraries. Of themselves, however, contraries cannot explain change: therein lay the error of the Pre-Socratics.(3) Contraries as such can neither act upon nor pass into each other; a hot body can act on a cold body but heat itself cannot act on cold; a hot body can become cold but heat itself does not become cold. The justification of this physical principle is found in the identification of the Aristotelian "form" with the Platonic Idea: contrary Ideas may be realised in the same object, but they cannot be united with each other; one Idea never passes into another. And yet there is no denying facts: cold bodies do cool hot bodies that are in their neighbourhood, and *vice versa*. Accordingly, Aristotle postulates a third reality whose function is to act as intermediary between the contraries: a persistent substrate in which the contraries that yield place to each other may inhere. In every kind of change, a distinction must be made between something that persists from start to finish and those contrary determinations, of which one disappears in favour of the other: this persistent substrate is something different from the determinations that successively qualify it. Aristotle called this substrate "matter" (4): but this word has become so fixed in its ordinary meaning that it needs to be marked by inverted commas, when used in its technical Aristotelian sense of persisting substrate.

At this point in the *Physics*, Aristotle abandons history in order to establish by argument his own view of change.(5) Change implies that a body passes from a state in which it lacks a particular perfection to a state in which it possesses this perfection. The various steps involved in this process are carefully distinguished and named: the substrate, which is the recipient of whatever succession occurs, is called "Matter"; the previous absence in the substrate of the particular perfection acquired as a result of the change, is called Privation; the result of the change, the newly acquired perfection is called Form. But since Privation consists merely in the absence of Form from "Matter," it is neither a positive reality, nor an independent principle: accordingly, the principles of change are reducible to "Matter" and Form. Aristotle illustrates his analysis by a man's progress from ignorance to knowledge: the starting-point of such progress is an individual substance who presents two aspects—humanity and ignorance; by means of education, one of those disappears and is replaced by its contrary—ignorance yields place to knowledge; the individual man persists during and after the process of education—he is the substrate in which this interchange of contraries happens. The difficulty of basing big conclusions on this seemingly trivial illustration jumps to the eye. Aristotle's scruples arise out of the deep-seated differences between substantial and accidental change.(6) A substance is an individual

with an existence and activity of its own—Plato or Socrates: an accident is a diminutive sort of reality which can exist only by inhering in a substance—qualities such as colours and tastes, actions such as building and killing. Now Aristotle's illustration refers only to accidental change: Socrates is successively ignorant and educated. It is not surprising, then, that the chasm which separates this kind of change from that by means of which substances originate should give our author momentary pause. He satisfies his scruples for the nonce by insisting on the general application of his analysis to every kind of change. He admits the greater obviousness of "matter" in the lesser kind of change: accidents are predicated of substances, and this grammatical relationship involves physical inherence in them as substrate. But this substrate is not one whit less necessary in substantial changes: plants and animals come from seed. However, his immediate obsession is the need of a substrate in all kinds of change: hence, he introduces instances of artificial products—houses, statues, etc.—which clearly imply a substrate. Consequently, this general analysis applies to all changeable beings: whatever undergoes change is compounded of "matter" and form. He has not altogether forgotten the third principle—privation—for he interpolates some valuable hints on its applications. Privation, he writes, may be an opposition either of contraries or of contradictories: an opposition of contraries when a substance loses one positive perfection and acquires in its place another positive perfection, v.g. a hot body cools or a white body darkens; an opposition of contradictories when there is question solely of the successive absence and presence of one and the same form, v.g. an illiterate becomes learned, a plant or animal is born. Neither has he forgotten the distinctive features of the deeper kind of change. Realising as it were the baldness of his passing reference to the origin of all living beings from seed, he hints at the necessity of a special kind of substrate for the generation of substance. This hint is merely a comparison expressed as a ratio: the "matter" of substantial generation is to the produced substance what bronze is to the statue, wood to the couch, raw material to the finished product.(7)

Some lines farther on, Aristotle refers to another solution of the problem of change based on the distinction between potency and actuality: this solution which is more fully expounded in the *Metaphysics*, concludes also to "matter."(8) Change as the realisation of what is possible implies a distinction between the possible and the actual: once you admit the fact of change, you admit the reality of that which can exist but does not yet exist. That out of which something comes into existence is, therefore, a presupposition of change. It is only one of these presuppositions, for in order that a thing be made you require as a second presupposition, the efficient cause. Aristotle terms the mutual presence of these presuppositions of new realities, potency. This kind of potency is different from logical possi-

bility or mere absence of contradiction, for it implies a physical capacity or power. And as capacity and power are different, physical potency is double : active and passive. Active potency is the power of the efficient cause to produce an effect. Passive potency is the capacity of anything to receive into itself a new perfection. This passive potency is identical with "matter" : for, in every kind of change, the being of the substrate and the non-being of the privation are united in such a way as to constitute the passive potency of the reality which is afterwards produced. All change may, accordingly, be described as a transition from potency to actuality : "matter" is being in potency, and the new reality brought into existence by the change is actualised being or being in actuality.

These are the outlines of the solution offered by Aristotle to that problem which had baffled the wits of philosophers since the time of Parmenides. Change is possible because our world contains a reality that is neither absolute being nor absolute non-being : its presupposition is something which may be described, on the one hand, as being that is relatively non-being and, on the other, as non-being that is relatively being. According to the *Physics*, "matter" is being that is relatively non-being : it is being because it is a substrate with a reality of its own existing prior to the change ; it is relatively non-being because, prior to the change, it had not that perfection which accrues to it owing to the change. According to the *Metaphysics*, "matter" is non-being that is relatively being : it is non-being because that out of which anything comes into existence cannot already be what it is on its way to be ; it is relatively being because that out of which anything comes into existence must contain the makings of what comes out of it—and Aristotle boldly calls that-which-makes-being-possible potential being, so that "matter," although actually non-being, is potentially and relatively being. Both solutions are employed in accepting Parmenides's challenge to to prove the possibility of change.(9) How, asked this latter, could any new state of things arise ? Not out of nothing for nothing can come from nothing : still less, out of something for what exists, exists, and it is absurd to speak of what already exists as a something coming into being. The conclusion of this dialectic had provoked an outburst of mirth among the Greeks : ridicule that was repaid mercilessly by the scornful Zeno. But laugh as the populace would, this *solvitur ambulando* attitude was beggarly fare for keener minds. Aristotle was the first to hoist Parmenides with his own petard : "matter" provides a dialectical solvent for all the puzzles of Parmenides. Consider it, first of all, as the substrate of contraries. That from which anything comes cannot be absolute nothingness : no Greek doubted this. But being can spring from relative non-being : it can spring, for instance, from a privation which is of itself non-being, but is an aspect of some substrate ; the being or product starts in its process of becoming from this non-being or privation,

and yet, this ancestry is accidental for Aristotle because the privation is in no wise part of the result—an educated man is not a compost of ignorance and knowledge. What-is, is: that, also, is incontrovertible; what already exists cannot be identical with any reality that is only on its way to existence. But being can spring from being or what already exists, if this pre-existent includes as part of itself a condition capable of fusing with a new reality emerging out of change—an ignorant man can become educated because he is a substrate having a predisposition towards education; and here, also, the ancestry is accidental for Aristotle because there is no contradiction between pre-existent and product. Again, consider "matter" as potency and see how it rebuts the dialectics of Parmenides. His dilemma is disjunctively incomplete: neglecting as it does the factor of potential being. A thing cannot come from nothing for the makings of anything must be something: true, retorts Aristotle, but, as a matter of fact, that from which the thing comes is potential being, and this is something. Neither can being, adds Parmenides, come from being: I agree in a way, replies Aristotle, but that out of which the new being comes is not actual being, but the makings of actual being, potential being.

Many and divergent views are held concerning the value of Aristotle's analysis in its application to facts, but there is practical unanimity about its complete success as a dialectical refutation of Parmenides. Aristotle's consciousness of this success makes him dwell complacently on the importance for the philosophy of Nature of the concept of "matter." Eleaticism had given a new direction to all subsequent thought: even those who did not dare outrage common-sense by an out-and-out denial of multiplicity and motion, felt themselves compelled by the arguments of Parmenides to restrict change to the local motion of eternally unalterable particles. Aristotle thinks that henceforth these half-way houses, these frail resting-places between Eleaticism confident of its dialectic and Common-sense confident of its experience, must collapse. Hylemorphism, or the theory of "matter" and form, satisfies the claims both of dialectics and of experience. It solves all problems of change, be those changes accidental or substantial. It solves, moreover, the problem of the ultimate constituents of non-living bodies, for in pulling body to pieces you lay bare its inner springs of structure and activity. There is, of course, a difference between the principles of being and those of becoming; privation is a strong point in the polemics of becoming, but, as it is absent from the product of change, it is unimportant as a principle of being. It is true moreover, that any individual is in a state of privation with regard to those perfections which it might have but has not: yet, such a way of looking at things is too far-fetched when you are seeking for these factors of any particular process which led to the production of a new reality.[10]

These are the essential points of Aristotle's first sketch of

the principles of being and becoming. Few moderns are likely to read it with the zest with which it was penned by its author. To many, a solution of this kind, brimful of dialectics and scanty of facts, must appear the merest logic-chopping. Two pleas may be made in its favour: one psychological and purely extenuating, the other metaphysical and decisive. Aristotle tackled this problem dialectically because of training and environment: factors that emerged from the historical development of Greek philosophy. He was dialectical for the same reason that Augustine was allegorical, Aquinas abstract, Kant critical, Hegel absolutist; contagious influences of age and race. The metaphysical plea is, I would urge, decisive. And by this I mean that those, who can penetrate through the husks of these Aristotelian abstractions to the kernel of thought within them, will find themselves face to face with choices that mark in philosophy the parting of the ways: choices at varying levels and with proportionate consequences—the choice between mechanism and anti-mechanism in the realms of matter and of life, and, beyond these limited spheres, the grave choice between theism and its rivals. A serious issue this latter, far too serious seemingly, to take its rise in the analysis of such a commonplace occurrence as a child's study of its first lessons! And yet who that has ever got to the heart of the problems of philosophy dare deny the ultimate significance of this and similar iotas.

Facts and Factors of Accidental Change.

Aristotle's general conclusions so far is that bodies which change are composed of "matter" and form. There are, however, several kinds of change (11): change of substance in generation and corruption; change of quantity in growth and diminution; change of quality in alteration; change of place in local motion. Accordingly, Aristotle distinguishes several kinds of "matter" and several kinds of form: but as the four kinds of change are reducible to change of substance and change of accidents, the leading implications of hylemorphism will be made sufficiently clear by discussing separately accidental and substantial change. Aristotle refuses on principle to prove the existence of change in the universe. There are facts which no sane mind calls in doubt: and amongst them, are the existence of bodies and of, at least, some kind of change in some of those bodies; the fact of change is made evident by experience. Even Parmenides, he asserts, was compelled to account for the facts of sense-perception: thereby mistaking, it would seem, the genuine import of the second part of the poem of the founder of Eleaticism.(12) It is true that the mechanical physicists had attempted to reduce every kind of accidental change to mere spatial change. But, as we saw, Aristotle had grappled boldly with, and, as he believed, had overthrown these formidable opponents. His conclusion was that the sensible qualities of bodies were, each

of them, genuine accidents distinct from the accidents of shape and of motion: qualitative change is not a mere disguise which mechanical motion wears for our senses.(13) On these presuppositions, there was no need to labour the obvious. Accidental change abounded everywhere in the universe: in the elements—in cooling and heating water or air, in drying and soaking earth, in kindling and flaming fire; in true mixtures—in the hardening of diamonds, in the dimming of the lustre of gold, in the heightening of the sheen of bronze; in living beings—in the growth and withering of trees, in the blooming and fading away of flowers; in animal life—singing itself away on the tree and through the grasses, or lazily feeding in the fields; in human life—working out hour by hour the future destiny of each of us by myriad processes in our bodies and in our minds; above all, in the artistic processes of human handiwork—topics rarely absent from Aristotle's mind when he is discussing the problem of change.(14) These innumerable facts of accidental change are classified under the three heads already given—alteration, augmentation and diminution, local motion. By a choice of words which was, in view of modern usage, to prove unfortunate he called all kinds of accidental change "motion." (15) And in accordance with his conclusions on the possibility of change, he naturally explains all accidental changes by his theory of "matter" and form. In such changes, the "matter" is always an existing individual and the form is always an accident.(16) Within these cycles of accidental change, then, Aristotle looks on existing individuals as fixed and permanent factors: individuals are the invariants of existence within this sphere—processes go on in them and processes take place among them; they are the bearers of all qualities and of all quantities—fluctuations of these accidents occur in them; they are the agents and patients of all accidental reaction—they act on, and are acted on by, one another without impairing the identity of their respective substances.

Facts and Factors of Substantial Change.

Aristotle did not think it necessary to give elaborate proofs of the existence of substantial changes.(17) This is easily understood: the Eleatics had, indeed, denied the existence of any kind of change and some of their successors had admitted changes only of quality or of location, but the majority of Aristotle's predecessors had accepted substantial change as a fact of daily and hourly experience. He was naturally content, therefore, with rather meagre proofs of a fact admitted almost by everyone. First of all, he illustrates by examples the distinction between accidental and substantial changes: for instance, the contrast between the processes involved in an act of intelligence and those involved in the birth of things. In the next place, he recalls and confirms Plato's admission of the mutual transformation

of three of the elements; and, then, he extends this mutual transformation to all four elements. The keynote to this part of his theory is his acceptance of sensible qualitative differences as fundamental: bodies exist in as many different kinds as our senses testify. This plain-man outlook runs through every age of the Aristotelian text: each bodily substance has its own distinctive set of sensible qualities, and a total change of that set involves a total change of substance. This attitude was not accepted without critical examination of the facts: witness his exhaustive criticism of the contrary views of his predecessors. But once it was accepted, our world became for him a theatre of countless substantial changes. Consider the mutual transformation of the four elements: every sheet of water at the earth's surface is being evaporated continually under the influences of the sun; part of that evaporation becomes more and more heated until it turns to fire—forming, Aristotle thought, comets, meteors and the Milky Way; another part of it is being gradually cooled until it becomes water once more and descends as rain; fire itself is being constantly destroyed by water, while earth can be destroyed either by fire or water. Every perfect mixture in the sublunary world is a compound of the four elements [18]: his *a priori* and *a posteriori* arguments in favour of that conclusion have already been expounded. As far as his knowledge allows, he pieces together thread by thread the facts of this interweaving of the four elements to form compound substances. These compounds must not be thought of as they were by Empedocles: a mere juxtaposition of the smallest parts of their constituents just as barley and wheat lie side by side in a granary or stones and mortar in a wall. In a perfect mixture the four elements are so completely changed that every part of the mixture is homogeneous with the whole: the smallest particle of flesh is as much flesh as the whole. Aristotle is aware, of course, of the existence of mechanical mixtures: not every union of the elements results in perfect mixture. But he is confident that when the four elements meet under appropriate conditions of quantity, interaction, and divisibility, they cease to exist as elements and combine to form homogeneous compounds. Perfect or true mixture is due to the fact that the elementary qualities act and react on one another in such a way as to produce a qualitative mean, that is incompatible with the existence of the elements as such and, therefore, leads to the formation of a totally new substance: the elements exist not actually but potentially in a perfect mixture. The homogeneous compounds thus formed may be inorganic or organic: copper, silver, gold, zinc, iron, stone, etc., in the world of minerals; root, wood, bark, leaf, etc., in the world of plants; flesh, bone, skin, hair, etc., in the world of animals. This formation of perfect mixtures is a different process from the absorption of one substance by another. Absorption is the total conversion of one body into another under the influence of which it comes [19]: for instance, a drop of wine is

absorbed in a hundred gallons of water; food is absorbed by living bodies. It is clear that absorption also implies change of substance: the wine ceases to exist as wine; and foods like bread and meat cease to be such and become part and parcel of living flesh.

These facts, and others of the same calibre, are at the root of Aristotle's hylemorphic theory in the non-living world. On them he bases two arguments. Here is the first.[20] Changes of substance occur in the mutual transmutation of the elements, in the formation of perfect mixtures, in all instances of absorption: for, all these happenings involve the disappearance of the distinctive sets of qualities bound up with particular substances and the production of a totally different set of qualities bound up with other substances. But a change of substance is impossible, unless, on the one hand, some portion of the old substance remains and, on the other hand, some portion of it passes away and yields place to an incoming portion of the new substance: unless you admit this much, you have to maintain annihilation of the old, and creation of the new, substance. Now the results show that the portion which persists during the change is an indeterminate principle capable of uniting successively with that other portion of various substances whence springs their characteristic and specific qualities: that indeterminate principle of substance was called by Aristotle "matter" or substrate; thanks to the Schoolmen, it has lived in history as primordial matter.[21] The results also show that the portion of the old substance which disappears and the portion of the new substance which takes its place are, each of them, a specific principle—each of them, when present, is the source of all those qualities that make the substance belong to a particular species; this principle was given by Aristotle a variety of names—oftenest, "form"; thanks to the Schoolmen, it has lived in history as substantial form. Bodies that undergo substantial change, therefore, are, in spite of their unity as substances, made up of two constituent principles: primordial matter and substantial form. Aristotle supports this fundamental argument by a second.[22] All sublunary bodies come into and pass out of existence: they possess within them, therefore, some principle capable of existing or not existing. That principle must be distinct from whatever it be in them that gives them actual existence and specific activity. Consequently, all sublunary bodies are composed of two principles, one which makes them neither necessarily existent nor necessarily non-existent, and another which makes them for a time actually existing and specifically active substances: and these principles are identified by Aristotle with primordial matter and substantial form.

Primordial Matter.

Aristotle has left us three general descriptions [23] of primordial matter: the famous negative description in the *Metaphysics*—

"I call (primordial) matter that which in itself is neither a substance, nor a certain quantity nor any other of those determinations by which being is specifically determined"; a positive description in the *Physics*—"I call (primordial) matter that which is the first substrate of each thing in such a way as to be no mere accidental portion of it while the thing exists, and as to remain on afterwards as an ultimate when the thing is desstroyed"; an analogous description, also in the *Physics*—"(primordial) matter is to the individual substance what bronze is to the statue, wood to the couch, raw material to the finished product." Primordial matter [24] is, then, a medium between nothing and actualised existence, between non-being and being: it is not sheer and mere nothing for every existing thing contains a portion of it; and whenever any particular substance is destroyed, its primordial matter is not destroyed but persists in some other substance as a real part of our universe. It is the sole invariant of generation and corruption: a substrate that precedes the birth of each individual, persists during existence as one of its essential constituents, and survives as ultimate residue the death of that individual. It must be, then, a wholly indeterminate reality: something that is neither substance, nor quantity, nor quality; a substrate whose essence is pure potency, and, as such, not anything definite but capable of becoming everything; a subject to which not one of the thinkable predicates belongs, and hence equally receptive of them all; a centre of indifference to all opposites; a purely passive, absolutely structureless, reality at the root of all things. This accumulation of negatives is, indeed, the only means of describing primordial matter: but descriptions of this kind always raise doubts. Long ago, Alexander was puzzled by the difficulty of distinguishing between substrate and privation in this wholly indeterminate reality: and nineteenth-century critics whose sympathies are strongly Aristotelian have denied the possibility of making any such distinction—primordial matter seems to them nothing but the privation itself.[25] But it must not be forgotten that this substrate is a reality present in all existing individuals nor that, however complete be the indetermination affecting any subject, the distinction between that which is undetermined and its lack of determination remains. Primordial matter is not then identical with privation: as a persistent substrate of every substance that comes to birth, its indeterminateness involves the capability of being made determinate; and owing to the cycle of substantial changes that goes on, it is so completely indeterminate as to be capable of every kind of specific determination. Its incapacity of existence by itself is due solely to the absence of a determining principle: as a potency, it is a positively real. How real primordial matter was for Aristotle is shown by his occasional willingness to style it substance, nature: always however with the expressed or implied restriction—potential.[26] It is potentially substance, potentially nature. It is not actually a substance for it cannot

of itself exist: yet as one of the two constituents of substance, it is a principle without which no substance can exist and may, therefore, be termed a potential substance; and for practically the same reasons, primordial matter, which of itself is incorporeal and possesses not a trace of activity of any kind, is spoken of, betimes, in the Aristotelian text as a potential nature.

Aristotle assigns to this primordial matter a number of properties: incorporeality, incapacity of existence by itself, passivity, unity, infinity, eternity, unknowableness, appetency for substantial form, and the rôle of principle of individuation. Primordial matter is incorporeal,(27) for it is not a body but the potency of body: physical bodies are perceptible to our senses by their qualities—but were primordial matter cold or hot, moist or dry, it would be already one or other of the four elements; mathematical bodies have no weight and as such cannot exist in a place—but the elements and compounds of which primordial matter is a constituent do exist in a place. Primordial matter is incapable of existing by itself (28)—"all alone before a rag of form is on": the simplest order of existing substances is that of the four elements. Yet, it is never absent from our world, for the corruption of one substance is the generation of another. And just as it has no existence of its own, so it has no activity of its own (29): it is a passive principle destined solely for the reception of substantial form. Its unity (30) consists in the fact that it is one and the same kind of reality in all bodies: though of course it is broken up into as many portions as there are separate substances in the sublunary world. It is infinite, not actually or spatially, but potentially (31): in the endless circle of substantial changes that encompasses bodies it is transmitted from one to another and is never exhausted. It is eternal (32)—never having come into, and never passing out of, existence: did it come or go thus, it would have a whence and a whither and could not be accepted as an ultimate principle. It is unknowable (33): unknowable to the senses for it has no determinate qualities; unknowable to the intellect for it is not a determinate essence; the only way of knowing it is by analogy. It has an appetency (34) for substantial form—a striving or longing or inclination that is not conscious desire but natural impulse: union with substantial form is the purpose of whatever reality it has got. It is, finally, the principle of individuation.(35) Aristotle in his theory of knowledge makes the substantial form the object of intellectual knowledge, the abstract concept. No difference of content can exist between the substantial forms of individuals within the lowest species: "they (Callias and Socrates) . . . are the same in form for their form is indivisible." Individuals, however, do differ: Callias is not Socrates. Consequently, the principle of individuation must be sought in primordial matter: "thy matter is not mine." Callias differs from Socrates because the substantial form of humanity is united in each of them with a distinct portion of primordial

matter. Primordial matter as pure potency does not exclude division into parts; and since it is the recipient of substantial form, specifically the same form may unite with different portions of it. In this way the multiplication of individuals within the species is explained. This fact, also, explains the transitoriness, of the individual: primordial matter being indeterminate has no necessary grip of any particular substantial form. And while Aristotle speaks as strongly almost as Plato about the incorruptibility of substantial forms, he teaches explicitly their birth and death.(36) He whittles down, in practice, his words about the eternity of substantial form to the level that substantial forms of themselves are increate and immortal, but their union with primordial matter brings about their accidental subjection to birth and death.

Substantial Form.

The main clue to the Aristotelian doctrine of substantial form is to be found in our author's criticism of Plato's theory of knowledge. Plato and Aristotle start from similar presuppositions on this point (37): first, the existence of science, that is, a system of reasoned deductions from indemonstrable but certain definitions and principles; secondly, the existence of objects of sense experience that are constantly undergoing all sorts of incalculable changes. And their common problem is to adjust these two facts: the world of science with its systematic truths that are valid everywhere, always, and for everyone, and are connected with one another by the bond of logical necessity; and the world of experience with its indefinitely variable bodies that rarely endure for long in the same state, that often at the same moment provoke conflicting and even contradictory beliefs, and that apparently lie side by side without being welded into any kind of system. Plato's solution was that the world of science refers to a world of realities distinct from the world of experience—the world of Ideas; that opinion or unsystematised knowledge refers to the world of experience; and that the world of experience "participates" in the true reality of the world of Ideas. That solution has provoked endless controversies: are those Ideas of Plato metaphysical or mythical or logical? Aristotle, at least, never dreams of construing the theory of Ideas as a flight of poetic fancy or a doctrine of logical predication: he accepts it as dogmatic metaphysics, implying the separate existence of a superphysical world of eternal and immutable entities which are the sole objects of scientific definition and scientific truth. And whether Plato did or did not defend so crazy a doctrine, Aristotle's incisive attack helps to emphasise the part played by the Idea in his own theory of knowledge. He urges against the Platonic view the fallacy of all those proofs that are advanced to prove the separate existence of the Ideas: then, he insists on the worthlessness of separately existing Ideas as an explanation of the existence and activity of the objects of experience.

Plato's arguments are not conclusive [38]: "for according to the arguments from the existence of sciences there will be Ideas of all things of which there are sciences, and according to the argument that there is one attribute common to many things there will be Ideas even of negations, and according to the argument that there is an object of thought even when the thing has perished, there will be Ideas of perishable things—since we can have a memory image of these. Further, of the more accurate arguments, some lead to Ideas of relations, and others involve the difficulty of the 'third man.' And in general, the arguments for the Ideas lead to the denial of things for whose existence those who maintain the Ideas are more anxious than for the existence of the Ideas; for it follows that not the Dyad but number is first, i.e., that the relative is prior to the absolute—besides all the other inconsistencies between the consequences which have been drawn from the theory of Ideas and its principles. Further, according to the assumptions on which our belief in the Ideas rests, there will be Ideas not only of substance but also of many other things . . . and yet according to the necessities of the case . . . there must be Ideas of substance only." Aristotle goes farther and insists that the Ideal theory, even if it were better founded, is useless.[39] "Above all, one might discuss the question what on earth the Ideas contribute to sensible things. . . . For they cause neither motion nor change in them. Again, they help in no wise towards the *knowledge* of the other things (for the Ideas are not even the substances of things, else they would have been in them); nor do they contribute to their being, since they are not *present* in the things which participate in them. . . . But further, all other things are not derived from the Ideas in any of the usual senses of the term—derivation. To call them archetypes and to say that other things 'partake' of them is to use empty words and poetical metaphors. For what is the agency which actually constructs things with the Idea as its model? . . . And . . . there will be many archetypes and consequently many Ideas for the same thing. . . . Further, the Ideas will be archetypes not only of sensible things, but of Ideas themselves. . . . So, one and the same thing will be both archetype and copy. Again, it is impossible that the substance of a thing and the thing of which it is the substance should exist apart; . . . Yet when the Ideas exist, still the things that share in them do not come into being unless there is some efficient cause; and many other things come into being (v.g. a house or a ring) of which Platonists say there are no Ideas." For these and similar reasons, Aristotle declares that Plato's Theory of Ideas multiplies instead of solving the problems of knowledge: in his effort to account for the things around us, Plato duplicates them—giving us two worlds of stars, of men, of animals, of plants and of minerals; "this is just as if one who wished to count certain things should fancy that while they remained fewer he will not succeed, but should first multiply them and then count." [40]

Despite this incisive polemic Aristotle sticks to Plato's distinction between the non-sensible essence of things and their sensible appearance: scientific knowledge must have for its object an unchangeable and necessary reality. Ideas will explain the world of things around us if they are dethroned from their Olympus, and made immanent as principles of knowledge and being in the particular objects of sense experience: humanity is not a thing apart from and outside of all existing men—if it were, how could knowledge of it contribute in any way to our scientific knowledge of man as they exist in the sensible world. But if the Platonic Ideas are embowelled in sensibly existing substances, they account both for the object of science and for the reality of things. Science requires not Platonic "Ideas or a One which is something over and above the Many" but the right to predicate one term of many objects: a right allowable in Aristotle's eyes only if the universal concept expresses what belongs to existing individuals by reason of their nature, and therefore, necessarily and always.(41) Once this conclusion was accepted in the interests of scientific truth, Aristotle was compelled to identify the class-concept of the lowest kinds with the substantial form. This concept represents the specific essence: that which makes Callias, Socrates, and Plato be men. But the analysis of substantial change has shown that the substantial form fulfils this same function: it is that constituent principle within each substance which by its union with the passive and indeterminate primordial matter forms an individual of a particular species. Aristotle accordingly identifies the two (42): substantial form and essence are frequently used by him to express from different points of view one and the same reality: the essence is distinguished from the sensible object by that permanence and unity which makes it an object of science; and in a similar way the substantial form is both a unitary principle that marks off one species from another, and a permanent principle that is eternally reproduced within the same species.

A secondary but helpful clue to Aristotle's doctrine of substantial form is to be found in two well-known habits of thought: his tendency to illustrate natural by artistic processes and his predeliction for biological study.(43) Art realises a figure or form in raw material or "matter": the sculptor chisels bronze into the shape of Socrates. Now Aristotle lays down that nature works after the analogy of art in production of substances: new substances are produced by the realisation of substantial form in primordial matter, after the manner in which statues are sculptured by the realisation of human outlines in bronze. He does not readily forget, however, the limits of this analogy: artistic skill results at most in a change of accidents. And his biological cast of thought leads him to develop in the *de Anima* a famous definition of the soul as substantial form (44): the soul is there described as the substantial form of living beings and, also, as the first actuality or perfection of a natural body

endowed with the capacity of life. A body capable of life, he adds, is one that readily serves as an instrument for the fulfilment of living functions: and thus the soul is the first actuality or perfection of a natural body endowed with these instruments. Substantial form is called *actuality* or perfection because it perfects or completes primordial matter: it is called *first* actuality because it precedes all those qualitative perfections that are found as specific attributes in the fully formed substance; finally, it is called the first actuality or perfection of a natural body capable of life to remind his readers that substantial form, as such, has no existence and no activity outside of or apart from that primordial matter with which it is united to constitute living substance. These two peculiarities of outlook—the artistic and the biological—affect also Aristotle's treatment of substantial form in the world of non-living bodies. In that world substantial form bears to primordial matter the relation of the determining to the determinable principle: the form is actuality, the latter is potency. And as primordial matter is pure potency, it owes the actualisation of all its potencies, whether of existence or activity, to the substantial form.

Substantial form may, then, be likened to a hidden architect within the composite unifying and actualising its indeterminate co-principle into a determinate substance. All definiteness, all activity, all intelligibility come from the substantial form.(45) It is the principle of all definiteness: dominating the divisibility of extended matter so as to bind its various parts into the singleness of a unitary substance. It is the principle of all activity: through it the composite, although consisting in part of utterly passive primordial matter, becomes capable of action and reaction. It is the principle of all intelligibility: through it the composite, although consisting in part of unknowable primordial matter, becomes an object of thought and of science—everything that precedes it is indeterminate and unintelligible, everything that follows it and does not come from it is purely contingent. In short, substantial form actualises primordial matter, and thus produces a substance that has a determinate existence, a natural activity, and an intelligible essence. Hence its superiority to primordial matter.(46) It is more being, more substance, more nature, more cause, more beautiful, more divine: more being and more substance for it is actuality; more nature and more cause for it is the source of all activity; more beautiful for it implies greater perfection; more divine for it is more like the highest form, God. Hence,(47) too, the wealth of synonyms by which Aristotle strives to convey the richness of this determining principle: ἐντελέχεια, because realised substantial form implies the completed perfection of substance; ἐνέργεια,—more loosely—because certain processes, those of generation, result in the manifestation of substantial form; εἶδος, because substantial form fixes a substance in a definite species; λόγος, because substantial form is the object of intellectual knowledge; οὐσία,

because substantial form is the essence of a thing; τὸ τί ἦν εἶναι, —probably, for no one pretends to be sure about this mysterious phrase—because substantial form expresses the abstract essence of a thing; φύσις, because substantial form is the principle of activity; μορφή, because substantial form fixes the species and the natural kinds are often distinguishable by their figure; τέλος, because substantial form is the result of generation and the goal of primordial matter; ὁρισμός, because the definition is a complete enumeration in proper sequence of the essential characteristics of a thing.

The properties of substantial form are appetency for primordial matter, incapacity of separate existence, immutability, causality, origin from the potency of primordial matter. Substantial form has an appetency [48] for primordial matter but this appetency is not to be interpreted as conscious desire: substantial form is the essential correlate of primordial matter, and this implies a natural inclination for union with it in the formation of substance. Substantial form—at least, the substantial form of non-living bodies—cannot exist alone [49]: as one of the essential parts of a single substance, it is necessarily immanent therein, and can no more exist apart from primordial matter than can vision apart from the eye or can roundness apart from the sphere. Substantial form is immutable [50] and cannot turn into something else: addition and subtraction, as regards the content of a substantial form, would result in a change of species; tack on sensation to the substantial form of a plant and the result is an animal, take away life and the result is a non-living substance. Substantial form is the principle of causality in each substance.[51] Its proper causality is formal, and consists in the immediate communication of itself to primordial matter for the purpose of forming a substance: this formal causality must not be interpreted as the production in the substrate of any reality distinct from the substantial form itself; it implies not efficiency but communication, and is the mere clothing of the substrate with its own perfections. But once embowelled in that substrate, the substantial form may be regarded as a source of efficiency and finality. Its efficient causality is manifested, within the substance, as a principle fashioning unto its own ends the primordial matter; and, without the substance, as a principle fashioning to the same end other substances. This doctrine is brought out most clearly in Aristotle's views upon the soul.[52] The soul acts as efficient cause within and without the organism: within the organism it brings about nutrition, growth and decay in plants, and these plus sensation in animals; without the organism it reproduces its like, plant begetting plant and animal begetting animal. And as all efficient causality, for Aristotle, is towards a definite goal, this efficiency of the substantial form becomes forthwith final causality. This finality is best observed in living beings. Every living being is a microcosm the parts of which subserve the whole:

and that adjustment of means to ends within each organism is effected by its substantial form or soul. It is ever regulating and directing all living processes to its own definite purpose. It not merely grows the organs as efficient cause, but it shapes them when growing them towards fixed results. And if its regulating activity met with no obstacle, it would bring forth in all fullness its perfections, and would result in a substance finished in its kind and, thereby, harmonious with the universe as a whole. Both this efficient and this final causality are also at work, according to Aristotle, in non-living substances: in them as in living bodies the substantial form exercises its threefold causality. Still this ontological identification of the formal, the efficient, and the final cause must not lead us to confound the three: the substantial form, as such, exercises only formal causality, that is, actuates primordial matter; and it is not in its function of substantial form that it acts efficiently and finally.

The question of the origin of substantial form remains. Aristotle's modification of Platonism compels him to abandon Plato's theory of the unity and eternity of the Idea. Individuals are many, and accordingly the substantial form, despite its identity of contents within the same species, becomes numerically multiple: "just as your matter is different from mine, so is your form different from mine." (53) Individuals are born and die, and accordingly their substantial forms cannot be unproduced and imperishable: "causes in the sense of forms are simultaneous with their effects." (54) Still Aristotle retains a hankering after Platonic phrases: substantial form is one and eternal—within the species.(55) It is one notwithstanding its numerical multiplicity in individuals because the species is one: every individual of the species possesses a substantial form alike in nature. It is eternal: unproduced, notwithstanding the birth in time of individuals, because the species has always existed; imperishable, notwithstanding the death in time of individuals, because the species can never perish. Phrases apart however, Aristotle holds that substantial forms come into and pass out of existence, and has to face the problem of their origin.(56) And since substantial forms cannot be pre-existent like the Platonic Ideas, they must come from primordial matter.(57) They pre-exist in primordial matter: not as preformed miniatures nor as latent germs; but in potency, awaiting the stimulating influence of the efficient cause. When the composite is produced, its substantial form originates from the potency of primordial matter; when the composite is destroyed, its substantial form lapses into the potency of primordial matter. And the secret of our world's rhythmic succession of substantial forms (58)? That secret lies in efficient and final causality. Each composite is an efficient cause, active through its substantial form and reproducing that form in other beings: hence the renewal of forms. This renewal follows a law of perfection in the order of finality: nature aims at what is best; and this best, which is nothing else than the

hierarchical organisation actually existing amongst the substantial forms of our world, governs the ceaseless generation and corruption of these forms.

Substance and Attribute.

Aristotle waxes lyrical in his description of the union of substantial form and primordial matter. "(Primordial) matter co-operates like a mother with the (substantial) form in bringing about everything that happens. . . . There is in all things something divine, excellent and desirable, and (primordial) matter is of its nature destined to desire and seek after this divinity. . . . The (substantial) form cannot possibly desire itself, for that self is never lacking: neither can its contrary (privation) desire the (substantial) form, for contraries mutually destroy each other. Herein lies the special feature of (primordial) matter: it may be likened to the female desiring the male, the ugly desiring the beautiful." (59) The union of the two gives a complete substance: and so complementary are they that one cannot exist apart from the other. Their union is not due to the mediation of an intermediary: they are to each other what the wax is to the impressed seal, the edge to the axe, the vision to the eye. "Proximate matter and form are one and the same thing, the one in potency, the other in actuality. Consequently to ask the cause of their unity is like asking the cause of unity in general; for each thing is a unity and the potential and the actual are somehow one. Therefore there is no other cause here unless there is something which causes the movement from potency into actuality." (60) Aristotle does not mean to deny by these words the real differences between primordial matter and substantial form. To maintain that primordial matter and substantial form are but different ways of regarding one and the same reality would contradict Aristotle's whole system and his explicit assertions.(61) These two principles are the same substance in a totally different way: substantial form is the actuality of the substance and primordial matter, the substrate, coexists with it as the potency of the same substance; thus each substance is, in spite of this dualism of objective principles, an absolute unity.(62)

But the substances, of which Aristotle is thinking, are existing individuals: minerals, plants, animals, with their respective attributes. Attributes, then, are factors in existing substances; and they are not extraneous additions like clothes. Aristotle admits as many kinds of attributes as there seem to be irreducible methods of modifying a substance without injury to its identity; he classifies their multitudinous modifications under nine heads—quantity, quality, relation, place, time, situation, possession, action, passion. All these attributes of existing individuals have not, however, the same connexion with the specific essence of their respective substances (63): some are properties, others accidents.

Properties in the strict sense are those attributes which, although they are not part of the essence, are common, necessary and peculiar to the species. All other attributes are adventitious realities which may or may not belong to an existing substance—they are present merely by coincidence in a particular individual, and have no necessary connexion with the specific essence of that individual. Properties, then, belong to individuals as existing and active members of a definite species: they are the natural concomitants of the substantial form, and come into existence with it the moment a substance is generated. Aristotle has exemplified such properties in the case of animals with a masterly wealth of details in his various biological treatises. His meagre knowledge of those sciences that deal with non-living bodies did not permit of his illustrating this theory of a concomitant resultance of properties from the substantial form in the realms of physics and chemistry: but it is taken for granted, everywhere, in his treatment of non-living bodies. The accidental attributes are distinguished from these properties by the fact that, although when present they inhere in the substance, they have no necessary connexion with, and do not come into existence concomitantly with, the substantial form. The individuals of certain species, for instance, have eyes—and these are properties; but these eyes may differ in colour—and this greyness or blueness is, for Aristotle, an accident traceable to the stuff out of which the eye is made. This stuff is itself the result of an eternity of inextricable interactions: hence, he speaks of the patient and of the efficient cause as the makers of accidents.[64]

A word about quantity. Every bodily substance exists in space and is measurable: hence it has quantity. But what Aristotle understood by the essence of quantity led, as we shall see, to controversy between Averroes and the Schoolmen. Here, it is worth noting that quantity is not, for Aristotle, an unchangeable attribute of matter in the sense that the same non-living matter always occupies the same volume. Quantity, as a property of matter, depends on the substantial form.[65] Now in the living world, all natural kinds have definite limits of less and more in size: cabbages never attain the stature of oaks; men do not turn the scale with elephants, nor do they rub shoulders with giraffes. This way of regarding quantity led Aristotle when dealing with non-living substances to conclusions that are totally foreign to modern views. The quantity of non-living bodies, also, depends on their substantial form. When a large volume of air is generated out of a small volume of water, the increase in quantity is not due to the intrusion of extraneous matter; but the pre-existing quantity of matter passes under the influence of the new substantial form from small to large—passes from potency to actuality as regards enlargement. This instance is typical of all substantial changes: in them, the quantity of the corrupted body disappears with the outgoing substantial form and the quantity of the generated body is totally

new, coming into existence for the first time with the incoming substantial form. But in absorption or growth, the already existing quantity does not disappear: the fresh material that becomes part of the absorbing or growing body loses both its substantial form and its pre-existing quantity, and is changed by the power of the new substantial form into a definite volume of the absorbing or growing substance.(66) The ordinary facts of contraction and expansion of matter are also explained in a way wonderful to moderns: contraction is for them a closer crowding together of immutable particles, expansion the separation from one another of these same particles. Aristotle thinks that contraction and expansion are due to the actual thickening and thinning of non-living matter itself (67): a brick could, he believed, occupy a volume of twice its previous volume by real expansion, that is, by its quantity passing from potency to actuality in greatness of size; and the same brick could occupy a volume of half its previous volume by real contraction, that is, by its quantity passing potency to actuality in smallness of size. Another remarkable consequence in this connexion, arising out of Aristotle's opposition to atomism, was his view of the individual unit in the non-living world.(68) Each sensibly homogeneous and continuous lump of non-living matter possessed in his eyes unity of being, and was a single substance: a block of marble, a log of wood, a lump of stone, a bar of iron, provided it was not perceptibly divided, was, however enormous its dimensions, just as truly a unitary individual as the tiniest visible chip that might be broken off it; and apparently, an ocean was just as truly a single substance as each jet of spray thrown off from its breakers.

Post-Aristotelian Greek Theories of Matter.

Our detailed review of Greek Cosmology comes to an end with Aristotle. A sufficient reason for this closure is that there is little new in the cosmological theories of his successors, the Epicureans, the Stoics and the Neoplatonists (69): and that this little new is but a hint of a modern theory of matter which must be hereafter fully discussed. Epicurus revived the atomism of Leucippus and Democritus: he modified it by attributing weight to the atoms, and by allowing them an indefinite rather than an infinite number of shapes and sizes; he spoiled it by assuming that, at certain moments and for no assignable cause, atoms when falling in the void may swerve very slightly from the perpendicular path. The Stoics in attempting a compromise between Aristotle and the earliest thinkers reached a view new to the Greeks. Those earlier philosophers had said that all bodies were made out of one or other of the four elements; Aristotle had said that bodies were made out of primordial matter and substantial form; the Stoics taught that bodies were made out of unqualified body and determinate qualities. Unqualified body meant for the Stoics that inert, triply-extended,

corporeal stuff destitute of shape and of qualities, which underlies every existing body. This unqualified body was said to be a substance in the true sense: a self-subsisting reality. And on this account, every addition to it by way of shape and of quality was said to be an accident. The Stoics taught, however, that unqualified body is never actually present in our universe without a definite shape and without definite qualities: these two constituents, unqualified body and the qualifying accidents, are inseparably united in every actual body. In addition, the Stoics admitted change of qualities in body; they denied change of substance—there is never a fusion of distinct bodies into one homogeneous mass; their distinctive doctrine in this connexion was their assertion of "universal mingling"—a mixture in which every part of one body is interpenetrated by every part of another, but a mixture in which each body still retains its own qualities. Plotinus attempted to unite the cosmologies of Plato and Aristotle. His view was that bodies are made of primordial matter and substantial form. Bodies have primordial matter as Aristotle says: but it is inaccurate to contrast this primordial matter with the "matter" of Plato—Plato's matter is not space but the potency of body. Bodies have also a substantial form in the Aristotelian sense: but for Plotinus, as for Plato, these substantial forms of sensible bodies are but copies of the Ideas. Thus we see that the only novelty, in Greek Cosmology after Aristotle's time, is the Stoic approach to the theory known in the nineteenth century as dynamic atomism. There is, then, no need to enter on the details of these Greek post-Aristotelian theories of matter. Even if there were, I should hardly do so for the thesis of this book is, that Aristotle has really answered the question first asked by Thales: of what are bodies made?

CHAPTER V.

THE ARISTOTELIAN SCHOOLMEN ON THE HYLEMORPHISM OF MATTER.

"In judging of the Schoolmen we must remember," writes Fr. Rickaby, *Scholasticism* (pp. 9-11), "how destitute they were of those instruments of study and research without which any modern student would consider the progress of his work impossible. Not that the privation was altogether a dead loss. Devoid of helps from without, men thought harder. For physics they depended upon their unaided senses. No telescope, no microscope, no battery, no chemical reagents; no museums, nor collections either. For the literary student there were books, manuscripts of course. He had in his hands, and by frequent quotation showed his diligent use of, most of the Latin Classics, Cicero, Virgil, Horace, Terence, Juvenal, Seneca, Quintilian; Pliny's *Natural History* he knew at least by extracts. Knowing no Greek . . . he had in his book-chest no Greek manuscripts. Supreme importance is therefore attached to the translation of Aristotle: indeed, it is not too much to say that had Aristotle never been put into Latin, scholastic philosophy never would have arisen. Abelard in 1136 had in his hands translations of what was quaintly entitled the *Perihermenias* (Aristotle on Interpretation) and the *Categories*. The second half of that same century possessed the whole of the *Organon* but no more. Had you asked a clerk of our own King John's Court who Aristotle was, he would have answered with a shrug of the shoulders, 'Oh, a crabbed logician.' The throne of the Stagyrite was not yet firmly planted in the West. By the middle of the thirteenth century, however, besides versions from the Arabic, a translation from the Greek of nearly the whole of Aristotle was achieved by two Dominicans, Henry of Brabant and William of Moerbeke. (The *History of Animals* does not seem to have been translated, nor the later books of the *Generation of Animals*, nor the end of the *Metaphysics*. To Aristotle the later Middle Age attributed a work, really by Proclus, known as *Liber de Causis*, extraordinarily popular.) All that the Schoolmen had of Plato was a fragment of the *Timæus* translated by Chalcidius, also the *Phædo* and *Meno;* further information about the philosopher was gathered from St. Augustine and sundry Neoplatonists. Chief

of these latter was the Pseudo-Dionysius, the Areopagite (probably a monk of the sixth century), whose treatise *Of the Divine Names* and *Of the Heavenly Hierarchy* had a great hold on the medieval mind. A still greater treasure was the works of Boethius, who was long the chief authority on Aristotle. Many fragments of the ancient learning were found embedded in the works of the Latin Fathers, notably St. Augustine, St. Ambrose, St. Gregory the Great, St. Isidore, Lactantius, and Latin versions of Clement of Alexandria and Origen. There was also a sort of Cyclopædia, the work of Martianus Capella, bearing the title of *The Nuptials of Mercury and Philologia.* Last but not least, diligently conned and continually transcribed, there was the Bible according to the Latin Vulgate." The result of these limiting conditions for progress in the empirical and the metaphysical sciences was that the medievalists were, in these branches of learning, men of one author. Not, indeed, of the whole of that author. St. Thomas, Scotus and the others commented on less than half the writings of Aristotle for the simple reason that only so much of these writings refers to metaphysics and to those portions of empirical science which are the basis of metaphysics. That half of Aristotle comprises about 750 double-columned pages in Bekker's standardised text. The whole basis of medieval science, both empirical and metaphysical, lies, therefore, within a surprisingly narrow compass. It must not be forgotten, however, that the conciseness and obscurity both of Aristotle's style and of his subject made the understanding of this half of his text a very difficult task. It is in their commentaries on this text and rarely elsewhere that we find the *philosophy* of the leaders of the School: each succeeding leader, however, added to his commentary on Aristotle a concomitant commentary on his predecessors; that is why the two volumes—*Disputationes Metaphysicæ*—of Suarez embodies the philosophical opinions of the whole School. These commentaries were extensive treatises: the lectures of St. Thomas on Aristotle, for instance, exceed in bulk his *Summa Theologica.*

The salient points of medieval Cosmology will be expounded in five chapters: two dealing with substance and three dealing with accidents. All that Cosmology is based on Aristotle: it presupposes, then, the scientific views outlined in the third chapter; it presupposes, also, Aristotle's cosmological criticism of his predecessors. But so little has hitherto been explained of Aristotle's Cosmology regarding material accidents that the medieval doctrine on quantity, quality, and motion, has to be built from the ground up. Not so the medieval doctrine of inanimate substance. A full account has already been given in the fourth chapter of Aristotle's theory of inanimate substance. With the exception of some important divergences that shall be pointed out, the Schoolmen endorsed every line that Aristotle wrote in reference to non-living bodies about the proofs of hylemorphism, the existence and nature of primordial matter and substantial form.

It would be meaningless, then, to repeat all this in two chapters that follow immediately a detailed account of Aristotle's teaching on these topics. Hence the fifth and sixth chapters must be read as extensive supplements to the fourth: they simply put before the reader points in the Cosmology of inanimate substance where the Schoolmen, pondering over the doctrine outlined in the fourth chapter, either developed more fully the implications of the Aristotelian text or discovered certain inconsistencies in that text.

The Proofs of Hylemorphism.

The Schoolmen endorsed Aristotle's view of primordial matter and substantial form as the ultimate constituents of inanimate bodies. And as he was their guide not only in philosophy but in empirical science, they accepted the proof of hylemorphism drawn from substantial change. For them as for him, the change of one inanimate substance into another substance was a frequently occurring and easily observable fact of experience. This change of substance was due sometimes to the absorption of one body by another: "when anything small is mixed with anything much greater, there is no true mixture . . . but the specific nature of the small is destroyed and becomes part of the great—this happens when a drop of wine is added to a thousand pitchers of water." (1) The mutual transformations of the elements are also instances of absorption. But change of substance is due sometimes to the fact that the four elements combine to form a single substance different from the components: this happens only when none of the components is greatly in excess of the others; thus, the four elements combine in varying proportions to form true mixtures. Both of these instances of substantial change were in their eyes irrefragable proofs of hylemorphism. They accepted also the proof based by Aristotle on the contingent nature of all sublunary bodies. As both of these Aristotelian proofs have been already expounded, there is no need to repeat them here: they appear in all the medieval commentaries on the Aristotelian text.

Some of the Schoolmen, however, developed a proof of hylemorphism that was not formulated by the Stagyrite. He held that the heavenly bodies did not undergo substantial change: and with that view all the School agreed. It is not quite certain whether he concluded from this fact that the heavenly bodies were not composed of primordial matter and substantial form: some Schoolmen thought he did; others thought he did not.(2) But whatever about Aristotle, the majority of the greater Schoolmen did teach the hylemorphic composition of the heavenly bodies, and, in striving to prove this composition developed a line of argument that betrays prevision of a problem which has become since the days of Leibniz one of the central problems of Cosmology: that of the conditions under which alone extended matter can exist as substance.(3) The following quotations

give an outline of their reasoning. "If," says St. Thomas,[4] "he (Aristotle) means that a heavenly body has in no way matter or subject, he is clearly wrong. It is evident that this kind of body is actually existing: otherwise, it could not act on sublunary bodies. Everything that actually exists is either an actuality or possesses an actuality. But a heavenly body cannot be an actuality because, then, it would be a subsisting form and an object of intellectual not sense perception. Therefore, there must be a substrate in a heavenly body underlying its actuality." This and similar texts have even been the source of the Thomist theory of the heavenly bodies: according to that theory, a heavenly body cannot be primordial matter alone, because it is active; nor substantial form alone, because it is not spiritual; hence, each of the heavenly bodies must be composed of primordial matter and substantial form. This argument gets a slightly different twist with the leaders of some of the other schools. "Since no body lacks extension," says St. Bonaventure,[5] "and since extension implies a corporeal nature, no body can exist without matter and no body can exist without form." Aegidius[6] is more detailed. "It must be composed of true matter and true corporeal form . . . because the accident must be rooted in its substance. Accordingly, the quantity and the quality of a heavenly body must be rooted in substance of some kind. Put yourself the question whether that substance be simple or compound. Simple it cannot be, for, then, it should be matter alone or form alone: but it cannot be matter alone for matter cannot exist without form; nor can it be . . . form alone, for immaterial forms cannot possibly receive and be the subjects of sensible accidents. Therefore the accidents of a heavenly body prove clearly that its substance is made up of matter and form." Three centuries later, Suarez[7] winds up his review of the arguments and authorities for and against this hylemorphic theory of the heavenly bodies by an admission of its probability. "And yet, as far as we can judge from signs and from effects, each of these heavenly bodies is probably composed of matter and form. First of all, everyone of those accidents that flow from matter—with the exception of corruptibility—is found in it: quantity is there, for instance, and it springs from the same root in every body. Then, rarity and density are present in heavenly bodies and they necessarily connote matter: density consists, in fact, in the presence of much matter in what is quantitatively small. . . . Again, some accidents of the heavenly bodies are merely of the receptive kind—for example, quantity which makes these bodies physically movable; whereas other accidents are of the active kind—for example, light and any powers they may have for influencing (terrestrial bodies); therefore, just as these latter accidents point to the presence of form, so do the former accidents indicate the presence of matter." The discoveries of modern astronomy have long since put an end to all this guess-work about the stuff

out of which stars and planets are made. But for the student of hylemorphism, this non-Aristotelian argument, in every variety in which it appears from the days of St. Thomas to those of Suarez, proves that, in the minds of some of the ablest medievalists, the fate of hylemorphism was not absolutely dependent either on the occurrence of changes of substance or on the contingency of sublunary substances.

Primordial Matter—What It Is Not.

Primordial matter is neither one nor all of the four elements. Aristotle had already proved this : and the Schoolmen [8] re-echo his agreements, stressing in our present reference the impossibility on such a supposition of substantial change. Albert the Great, whose peculiar theory of mixture has made him suspect on this topic, admits this explicitly.[9] "We teach that there is one (primordial) matter distinct from the four elementary sensible bodies : but we teach that this (primordial matter) never actually exists distinct from all four bodies but is separated now from one of them and now from another of them—that out of it as matter those bodies which are called elements are generated." For exactly the same reasons the Schoolmen [10] refused to identify primordial matter with either the atoms of Democritus and Epicurus or the seeds of Anaxagoras. They rejected also the Arabian attempts to thicken the fibre of primordial matter. Avicenna held that the ultimate substrate of substantial change was a primordial matter which was inseparably united with an incomplete and quasi-generic form, the basis apparently of extension and division. None of the greater Schoolmen [11] admitted this view : there was not the slightest trace in the activities of bodies of this inseparable and incomplete form ; there was no sufficient reason in the processes of substantial change for its assumption ; its presence would destroy the unity of subsequently formed substances ; finally, its presence would make changes of substance impossible. Averroes fastening on certain texts of Aristotle held that primordial matter was a substance with indeterminate, inseparable, ingenerable, incorruptible dimensions that were at most accidentally changeable : in other words, a quantified substrate that had no special density or rarity, no special size or shape. And he implied that this indeterminate quantitativeness was moulded into the various special dimensions of existing bodies by the substantial form. St. Thomas [12] apparently accepted this view of primordial matter in his youth, but he changed his mind later on and, in the *de Natura Materiæ*, he marshals against it almost a score of arguments. He points out that this view of primordial matter cannot be reconciled with Aristotle's explicit teachings on the indivisibility of primordial matter. He argues that these indeterminate dimensions are either educed from the potency of

primordial matter or not; if educed, they must have been previously in potency and, hence, primordial matter could be deprived of them—a supposition that Averroes denies; moreover, if educed they can have been educed only by a change in the primordial matter under the influence of the substantial form and, hence, they cannot be indeterminate—a supposition that Averroes cannot admit; therefore, these indeterminate dimensions are not educed from the potency of primordial matter by the form—a conclusion that involves an absolute contradiction for Aristotle because it implies that there are three principles of substance, primordial matter, the substantial form, and the alleged indeterminate dimensions. He urges also that quantity, whether indeterminate or determinate, supposes always the presence of substantial form. Suarez and some of the Jesuit Schoolmen did not admit as certain that bodies in changing their substance lost everything except their primordial matter, but they spoke of this alleged permanent core of reality as primordial matter *plus* certain accidents: thereby assenting with St. Thomas and Scotus to the rejection of this Averroist interpretation of primordial matter. The Schoolmen, then, stood loyally by Aristotle's famous negative description: for them as for him, that which is of itself a complete substance, or that which has of itself either quantity or quality or any other kind of accident, cannot be identified with primordial matter.

Primordial Matter—What It Is.

St. Thomas, when commenting on this negative definition, insists that Aristotle in denying that primordial matter is either a complete substance or an accident, either a substantial form or the privation of substantial form, does not thereby deny that it is a positive reality.(13) Primordial matter cannot be absolute nothingness for it is one of the essential constituents of those undeniable realities, material bodies. Moreover, if it were nothing, there would be neither generation nor corruption but creation and annihilation in the world of matter. It is, then, a genuine reality of some sort. Further, it is a reality distinct from substantial form: realities which are actually separable are certainly distinct from each other, but primordial matter persists during those substantial changes that involve the disappearance of the old substantial form and the appearance of a new substantial form; realities which are essentially simple cannot owe their intrinsic being to anything outside themselves, and primordial matter, even when united with substantial form in a substance, preserves its own essentially simple reality. Hence St. Thomas approves that other Aristotelian description of primordial matter as the first subject of which each substance is made and which persists in each substance after it is made, but which, neither before nor after the making of the substance, exists as an accident: as first subject, it does not presuppose any other substrate; as the subject out of which the substance is made, it is distinguished

from substantial form, for this is the goal of generation; as something that perseveres after the substance is made, it is distinguished from privation for this is but an accidental principle of generation. Despite its distinction, then, from substance, accident and substantial form, primordial matter as one of two ultimate constituents of bodies must be a genuine reality. It was for the purpose of emphasising its genuine reality that Aristotle sometimes spoke of primordial matter as substance: an inconvenient usage even when the qualification—potential—is added. The Schoolmen defend this usage on the ground that primordial matter, being a principle of substance, cannot belong to the category of accident, and must be somehow linked up with the category of substance: A substance is a self-subsisting reality of a definite species: hence a full-blown substance implies completeness of self-subsistence and completeness of species. Now, primordial matter cannot by any stretch of language be put down as an accident: it does not need anything distinct from itself as subject of inherence in order to exist. But the Schoolmen spoke of it as an incomplete substance: it is incomplete in regard to self-subsistence because, although it does not need a subject of inherence, it cannot exist without the co-existing principle of substantial form; it is incomplete in regard to definiteness of species because, although it is one of the two constituents of any specific substance, it is that indeterminate constituent which lacks all specific determination either of essence or of activity. This medieval terminology about "incomplete substances" is not popular nowadays: it has its obvious difficulties. But whatever about the elegance of the term, the use of it in reference to primordial matter proves beyond cavil that the Schoolmen believed this factor of substance to be something real.

The Scotists and the Suarezians are above suspicion on this question: as we shall see, they declared that primordial matter had, of itself, an entitative actuality. The Thomists objected to the application of this term—actuality—to primordial matter. But that linguistic objection does not imply that they differed from their opponents on the problem of fact: the positive reality of primordial matter. Any representative selection of the texts of St. Thomas proves this.(14) Take the following. "Matter of itself is potential being." "The actuality towards which primordial matter is in potency is subtantial form; and therefore the potency of matter is none other than its essence." "It is true that matter has its exemplar idea in God, but this idea is not different from that of the composite: for matter of itself has neither being nor knowability." "Matter exists for the sake of things; it is in some sense a thing because it is the potency of things; it is also in some sense the substance of a thing because it enters into the make-up of substance." "In whatever bodies there is composition of potency and actuality, that which holds the place of the primary potency or primary subject is incorruptible. That is why primordial matter is incorruptible even in

corruptible bodies." "Primordial matter was created neither wholly without form, nor under one common form, but under distinct forms." "Primordial matter receives substantial being by means of the form, and, therefore, it must be created under some particular form—otherwise it would be in actuality. But while existing under any particular form, primordial matter is in potency towards other forms." "The destruction of a body cannot result in primordial matter in the sense that this matter would continue to exist without a form because matter of itself cannot exist." "Primordial matter is that first subject which does not exist in any other." "The very nature of primordial matter demands that it cannot be in any other but that it should be itself the first subject." "You must know that primordial matter is said to be numerically one in all things." "That is called matter which has being from some other conjoint reality, for matter of itself has incomplete being or rather none at all." "Although primordial matter cannot exist by itself it can be considered by itself." "Activity is proportionate to the grade of actuality in being, and, therefore, the greater the defect of being, the less the activity: this is clearly seen in reference to primordial matter for, since it embodies the lowest grade of being, it has no active power." "Since matter is, as such, potency, the primordial material principle must be foremost in potency, and, thus, most imperfect." "That is called primordial matter which is in the category of substance as a potency of some kind distinct from species and form and privation, but yet capable of receiving forms and privations." "Primordial matter, although without form, is an imitation of the First Form: for, however feeble be that being which it has, it is, despite its feebleness, an imitation of the First Being." "When Avicebron argues that since there is a Being which, itself unmoved, is the cause of motion, namely, the First Maker of all things, there must also be something which is merely moved and passive, his conclusion is sound. But this being is primordial matter which is sheer potency just as God is sheer Actuality." "Primordial matter which is the first recipient holds in reference to passive potency that same place that God, who is First Agent, holds to active potency; accordingly, matter is its own passive potency just as God is His own active potency." "If a definition of the essence of primordial matter could be framed, the *differentia* would be its own relation to form, the genus its own substance." "Strictly speaking, that which is in potency to substantial being is primordial matter." "You must know that although primordial matter has not of itself any form . . . it is never stripped of form. It cannot, however, exist of itself: for, since it has not of itself any form, it cannot be in actuality because actual being results only from form; it exists (of itself) only in potency." "The form is a part of the composite and the composite as a whole is made up of it and of the matter." "Matter in its essence must be distinct from all substantial forms and their privations

which are the terms of generation and corruption." "Matter has not strictly an essence but is part of the essence." "When we observe that what is air sometimes becomes water, we must admit that something existing under the form of air sometimes exists under the form of water: and in this way, that which is something distinct from the form of air and the form of water holds the same relation to these material substances as bronze does to the statue, wood to the couch, and everything raw and unfinished to the form; and this something is what we say to be primordial matter." "Primordial matter has of itself potency; and since potency is a good, it follows that good is included in primordial matter of itself." Who can read these texts and doubt that St. Thomas held the positive reality of primordial matter? Some of them read thin, some of them read thick, but none of them in their context casts the slightest doubt on the positive reality of primordial matter. Nor was this reality denied by any of the Thomists: they never attempted any far-fetched explanation of those texts that read thick; and they conducted the controversy about primordial matter as sheer potency on grounds that never infringed the claims of primordial matter as a positive reality. "Matter has a proper essence distinct from form: hence the form is extrinsic to it; still, that essence of matter implies an essential relationship to actuality or to form, a relationship, I mean, that is not prædicamental but transcendental." These are the words of a seventeenth-century Thomist.(15) And Bannes, the supposed *enfant terrible* of Thomism, writes towards the end of the sixteenth century. "Matter is a true incomplete substance. Matter is the prior incomplete substance. Therefore it is not an accident. It is a real being: it is the subject of real transmutation, that is, of generation: it is not an accident in another subject for it is the first subject. Therefore, it is a substance. No substance can be made out of what are not substances. But substances are made out of matter. Therefore (matter is a substance)." (16)

Origin and Unity of Primordial Matter.

The Schoolmen taught, in opposition to Aristotle, that primordial matter was created at the beginning of the world: rather con-created, for the term of God's creative activity was a world of substances. But once created, they held it to be ingenerable and incorruptible; meaning thereby that it persists unchanged through all changes, whether of accidents or of substances.(17) This identical persistence throughout change was the basis of their belief in its unity: everywhere and everywhen, its nature was the same; it was a substrate of itself absolutely indifferent to the comings and goings of either substantial or accidental forms; whenever the necessary extrinsic causes were applied to any portion of primordial matter, the results were the same as regards the subsequent product of generation. Moreover, every

portion of primordial matter displayed the same natural need for union with substantial form. And the Schoolmen built on this appetency of matter for form a theory of passive evolution. This theory meant merely that primordial matter may pass unchanged through all the cycle of sublunary substances: beginning with the transmutation of the four elements and ending with man, an advance that gradually prepared its potency at each stage for higher and higher forms. "There are varying levels of actuality among substantial forms. Primordial matter is first in potency towards the forms of the elements. And when existing under these elementary forms, it is in potency towards the forms of mixtures; and that is why elements are the makings of mixtures. And when existing under the forms of the mixtures, it is in potency towards the vegetative soul because this kind of soul is the actuality of a body. In the same way, the vegetative soul is in potency towards the sentient soul and the sentient soul towards the rational soul. . . . Elements exist, then, for the sake of mixtures; mixtures for the sake of living beings; among living beings, plants for the sake of animals and animals for the sake of man: because man is the end of all generation." (18)

A War of Words.

A doughty controversy was waged over the question whether potency or actuality was the more fitting term to apply to primordial matter: Thomists plumping for the use of the term, potency; Scotists and Suarezians allowing, according to the occasion, the use of both terms. Thomists (19) insisted that primordial matter was of itself mere and sheer potency: that is, a reality whose essence consists solely in its relation to the actuality of substantial form. They meant by actuality of essence that which makes a thing be in a determinate species or genus; and they refused to allow any other meaning to actuality of essence. They concluded, then, that since primordial matter was a reality which was specifically determined only by something else, namely, the substantial form, it ought not in strictness to be termed an actuality of essence. Scotus and Suarez (20) fastened on the fact that primordial matter even in union with substantial form preserves its own simple reality, and concluded that it has an actuality of essence of its own distinct from that actuality of completed essence which results from union with the form. They concluded that, while in reference to the actuality of complete essence it might be rightly called mere and sheer potency, it ought to be called, in reference to its own intrinsic indeterminate and incomplete reality, a distinct actuality of essence. Thus both parties to this dispute recognise the same dose of reality in primordial matter. The source of their quarrel lies solely in the different meaning they give to essential actuality. "I ask our opponents," writes Goudin,(21) "what they understand by essential actuality. Either they mean by it everything

that is not nothing in the sense that actuality is opposed to nothingness, and that whatever is not nothing may be called an actuality; and according to this meaning, (primordial) matter is certainly an actuality because it is something and not nothing. But this use of the word, actuality, is a wrong use: for potency is also a reality and enters into the make-up of created being. Or they mean by essential actuality something determinate in the order of being and something expressing a special mode of being—which is the meaning of St. Thomas when he says actuality is that which determines potency; and in this meaning, (primordial) matter is not an actuality because it is of itself something indeterminate, and something indifferent in reference to all species of material being."

The Distinct Existence of Primordial Matter.

The cosmological question whether primordial matter has of itself an existence of its own is really an offshoot of the dispute about the distinction between essence and existence in concrete individuals. All the Schoolmen admitted some kind of distinction between essence and existence in a concrete being: but they contended fiercely about the nature of that distinction.(22) St. Thomas and the Thomists maintained this distinction was real; Henry of Ghent, Durandus, Suarez and a host of disciples maintained it was purely conceptual although founded on something real; Scotus and the Scotists maintained it was a formal actual distinction based on something real. The consequences of this dispute in Ontology were logically accepted by the respective Schools in Cosmology. All the opponents (23) of a real distinction between the essence and the existence of a concrete being held that primordial matter had of itself an existence of its own distinct from the existence of substantial form: for Scotus, this existence of primordial matter is independent of the existence of substantial form; for Suarez, this existence of primordial matter is so dependent on the existence of substantial form that it cannot be realised naturally without this latter. On the other hand, Thomists (24) deny a distinct existence of its own to primordial matter. Unity of existence is necessary, they urge, to unity of being. Had primordial matter a partial distinct existence of its own, this existence should be conceived as potency both in regard to the form and in regard to the partial existence of that form: existence, however, is the ultimate actuality, and accordingly cannot be thought of as a potency; therefore, primordial matter must owe its existence to the existence of the substantial form. The Thomist view, then, is that a single actuality of existence actuates primordial matter and substantial form. The substance which results from the union of matter and form involves a double relationship: one of matter and form; another of this composite and the actuality of contingent existence; the contingent existence of any substance is neither its form nor its

matter but a distinct actuality that accrues to the substance by means of the form. Distinct realities can concur in a single actuality of existence only when their nature is such that one cannot be realised apart from the other. Primordial matter is irrealisable without form because it is of too indeterminate a nature to exist by itself: it could not exist without some specific degree of being—unless it would exist simultaneously as being and non-being. Moreover, a substantial form that is intrinsically dependent on primordial matter cannot exist without this latter. Existence is the actualisation of a specific essence: and a specific essence is the result of the union of matter and form. This union is, consequently, a presupposition of the actuality of existence. Hence the Thomist concludes that existence belongs strictly neither to matter nor to form: it is a third reality distinct from these constituent principles of substance: a third reality which results from an extrinsic cause. "Existence," writes St. Thomas,(25) "is the proper actuality not of matter, but of the whole substance: for that actuality belongs to that of which we can predicate existence; existence, however, is not predicated of matter but of the whole. Hence matter cannot be said to be that which exists: it is the substance itself which exists." As we have already noted, Suarez is much nearer Thomism here than is Scotus. "Scotus, Henry and Gregory seem to deny that this existence of matter depends in any way on the form and its union with matter: but the contrary view," continues Suarez,(26) "is generally admitted because although matter has a proper existence of its own, yet it is so imperfect that it cannot naturally exist without the help of the form: and this is what is styled the dependence of matter on form." And of course, the Thomists, admitting as they did the distinctive reality of primordial matter even when united with the substantial form, did not deny that, in one sense, the actuality of existence which fell on primordial matter after union was distinct from the actuality of existence which fell on the substantial form.

With this controversy, we may link up the problem whether God could preserve primordial matter in existence without substantial form. St. Thomas and the Thomists held that the isolated existence of primordial matter was as great a contradiction as a square circle, and consequently impossible of accomplishment even by God. "If unformed matter had been created first, it would thereby have been in actuality. Creation implies this, for the term of creation is being in actuality. But that which is actuality is the form: therefore, to hold that matter had a previous existence apart from form is tantamount to holding that actual being exists without actuality—and this is contradictory." "God cannot secure that a reality should simultaneously be and not be, nor anything else that involves contradiction. The existence of primordial matter apart from substantial form would be a contradiction, because everything that is in actuality is either an actuality itself and a potency that shares in some

actuality. . To be an actuality is, however, contrary to the nature of primordial matter for its proper nature is potential being. Therefore primordial matter cannot be in actuality except in so far as it shares in some actuality. The actuality in which it shares, is, however, none other than the form. To affirm, then, that matter is in actuality is really to say that it has some form. That is why to speak of matter as in actuality apart from a form is to affirm that contradictories can co-exist. (Therefore, this can not be done by God.") [27] Scotus, Suarez and their followers took a different view of this possibility: Scotus held that primordial matter apart from substantial form can be kept in existence by God; and Suarez agreed with him to the extent of affirming that it is impossible to prove the contrary.[28] Their contention is that primordial matter has sufficient reality of its own to be kept in existence by Omnipotence. The solution depends on man's grasp of what is possible and what is impossible: a grasp that dwindles away almost to nothing in difficult problems. And even those who are thoroughly convinced of the logical strength of the Thomist view will recognise the source of Soto's diffidence here. "It is probable," writes this able Thomist,[29] "that God can keep matter in existence apart from form. And in saying this, I trust I am not forgetting the respect due to the grave authority of St. Thomas: first, because the point at issue is of little importance; secondly, because I have no intention of denying that his solution best accords with the principles of Aristotle and can be strongly defended. It is possible, also, that I am mistaken. There is one argument, however, that appeals particularly to me: my intellect cannot but hold that, since primordial matter and substantial form are distinct realities and since neither of them is a part of the other, God can keep in existence one of them apart from the other, for we must not deny God's power except there be irrefragable proof of contradiction: and certainly, no such proof is forthcoming in this present controversy."

The Possibility of Accidents in Primordial Matter.

The vast majority of the Schoolmen [30] held, with St. Thomas and Scotus, that all the accidents of the elements are destroyed when these elements are corrupted in the generation of an inanimate true mixture, and that all the accidents which are present in that true mixture when it is generated have been produced anew. "Accidents [31] do not pass from subject to subject, in the sense that the same numerical accident which existed previously in one subject can be found afterwards in another: for the accident owes its numerical identity to the subject." "When this fire is made out of this air, specifically the same heat remains but in greater intensity: still, numerically the same heat does not remain because the same subject does not remain. . . . (The same numerical heat) is incidentally destroyed by the corruption of its subject." "It is impossible that accidental dispositions

of any kind should pre-exist in matter prior to the substantial form." Elsewhere St. Thomas declares explicitly that corporeity, in a text where this word means the accident of quantity, "falls away into nothingness when the human body rots." "It must be held that no accident retains its numerical identity in a newly generated body but that any previously existing accident perishes owing to the corruption of its own subject at the moment when the substantial form disappears; and that a similar accident is born in its stead as a result of the generation of a new substantial form." The basis of this view was the Aristotelian doctrine of the nature of the accident. Substances, and they alone, are self-subsisting realities; accidents are not self-subsisting and can exist ordinarily only by inhering in some kind of self-subsisting reality. "Forms (32) and accidents and all such realities are not said to be beings in the sense they can exist alone but in the sense that by reason of their presence something exists: whiteness is said, for instance, to be a being because its presence makes a subject white. Hence, according to the philosopher, accident may be said more strictly to belong to, than to be, being. That is why accidents and forms and realities which are not self-subsisting, are rather co-existences than beings." "The nature of accident is imperfect because it implies inherence in, dependence on, a subject and consequently implies union with that subject." "In strict language, that which is in potency to substance is called primordial matter, that which is in potency to accident is called a subject. The reason is that the subject gives being, i.e. existence to the accident—the accident receiving being only through its subject: hence accidents are said to be in their subject whereas the substantial form is not said to be in its subject. This is also the difference between the subject and the primordial matter: the subject is a reality which does not receive being by means of union with some reality other than itself, it has being, complete being, of itself. . . . In short, substantial form gives being to primordial matter, but the accident does not give being to its subject: it is the subject which gives being to the accident." Moreover, Aristotle (33) in several texts seems to assert that change of substance involves the disappearance of every reality except primordial matter. And, therefore, when some thinkers proposed the contrary doctrine most of the Schoolmen rejected it. Primordial matter, these Schoolmen argued, is of itself neither adapted as a potency for the immediate reception of accidents nor capable as a substrate of ultimately upholding them. "No accidental disposition can intervene between . . . any substantial form and its matter. The reason is that matter is in potency to various actualities according to a definite order: hence that which is absolutely first in the order of these actualities must be admitted to be the first actuality of matter. But the first of all actualities is being. Therefore, matter cannot be thought of as warm or quantified before it is actual being. Actual being comes, however, from the substantial form, for that form causes being absolutely. . . .

Therefore no accidental disposition of any kind can pre-exist in matter prior to the substantial form." (34) Thomists supported this argument by their thesis that primordial matter has no independent existence of its own. A substrate that has not of itself self-subsistence cannot ultimately support realities like accidents which need to inhere in something else for the purpose of subsistence. Finally, if accidents of any kind exist in and are proper to primordial matter, they must somehow emanate from this latter: a consequence that would be incompatible with the generally received doctrine of the passive nature of primordial matter. For these and cognate reasons, St. Thomas and Scotus taught that all material accidents really and physically inhere in the inanimate composite substance and receive from it their actuation. The student must not be led astray by the fact that Thomist and Scotist speak betimes of certain accidents as flowing from primordial matter and of others as flowing from substantial form: thus quantity and certain passive qualities are said to flow from primordial matter, while active qualities are said to flow from the substantial form. This language is based on the affinity in nature between certain accidents and one or other of the ultimate constituents: all it means is that the presence of such and such an ultimate constituent is the basis of such and such accidents in the composite: it never means that either primordial matter or substantial form is a sufficient substrate for any material accident.

This unity of view regarding the destruction of all the accidents of the four elements at the moment of the generation of a true mixture was rendered more emphatic by a startling variety of opinions as to the exact nature of the newly produced accidents. The first difference of opinion arose between Scotus and St. Thomas. St. Thomas (35) held that the accidents of the four elements remain virtually in the true mixture; and he declares this virtual permanence of these accidents is secured by the origin of qualities that are specifically the same as those of the destroyed accidents. Scotus also held the virtual permanence of the accidents of the elements in the true mixture: but he denies that this virtual permanence is explicable by the origin of qualities that are specifically the same as those of the destroyed accidents. " The elements do not persist as substances in the true mixture: nor ought one to say that they remain by reason of their qualities —extreme qualities do not exist in a mean quality. Therefore, elements remain in the true mixture somewhat after the fashion in which sentiency and life remain in the rational soul." (36) In short, Scotus holds that the virtual permanence of the elements in a true mixture is to be explained by that fact that the substantial form of this mixture contains in a more perfect way all the perfections of the substantial forms of the elements. The reply of the Thomists is to deny the parity: the rational form is superior to the animal and vegetable forms; moreover, the characteristic activity of the elements is far less perfect when in

the true mixture than when the elements exist alone. But the Thomistic School,[37] while accepting St. Thomas's view that the virtual presence of the elements in the true mixture is explicable by the accidental qualities of the latter, never succeeded in reaching unity of opinion on the details of this virtual presence. Many held that the four qualities of the elements are replaced in the mixture by a single quality: a mean quality that bears the same relation to the nature of the extreme qualities of the elements as pale does to black and white. This mean quality is the proper quality of the mixture: it varies however in different mixtures owing to the different proportions in them of the elements. Some of these Thomists spoke of that mean quality as actually simple: it is not really made up of the different qualities of the elements—it is not partially hot and partially cold and so on, but it contains virtually all the qualities of the elements; and it differs from the qualities of the elements, not merely in intensity, but in kind—just as redness differs from whiteness and blackness. Other Thomists spoke of that mean quality as really composite —it has in it something of heat and something of cold and so on; and when one of these contraries within it grows more intense, the other grows less intense. Another group of Thomists held that the four qualities of the elements were represented in the mixture by two simple qualities: one a mean between the hot and the cold; the other a mean between the dry and wet. A fourth group held that the elements were represented in the mixture by all four qualities formally: but while maintaining the specific likeness between the qualities of the elements and of the mixture, they denied, as loyal Thomists, the numerical identity of these qualities.

Gregory, Auriol, Marsilius, Aegidius, Suarez, Toletus and many of the later Jesuit Schoolmen opposed this teaching of the Thomists and Scotists regarding the destruction of all accidents in changes of substance.[38] These illustrious dissenters held that certain accidents may persist unchanged during processes of substantial generation and corruption: for instance, the accident of quantity and other accidents that are not specially connected with the outgoing substantial form and are necessary dispositions for the incoming substantial form. And when challenged for a sufficient substrate for these persisting accidents, they retorted that primordial matter had sufficient essential and existential actuality of its own to act as their subject of inhesion. Suarez is the best exponent of this theory of the possibility of accidents in primordial matter. He allows that the Thomistic and Scotistic view is probable, but, in view of the objections that can be raised against that view, he puts forward the opposing view as more probable. These objections are four: certain facts of experience suggest the persistence after substantial change of some previously existent accidents: the need of a corporeal and extended patient at the instant of substantial change; the need of distinctive proximate dispositions for each incoming substantial form; the

danger of materialising the human soul. None of these objections are concretely illustrated in regard to non-living substances; a consequence of the medieval state of physics and of chemistry. Medievalists held that all non-living bodies were mixtures, either apparent or true, of the four elements, but they had no detailed knowledge of the structure of non-living true mixtures or of the stages of their formation: accordingly, they transferred the battle-ground of this and similar disputes to the realm of biology—a science in which Aristotle's writings were more detailed.

The facts that gave rise to the first Suarezian objection were drawn from the likeness between the body when alive and shortly after death: a corpse preserves for some time its heat, its flexibility, its colour; and preserves even longer its quantity, its shape, its scars. Thomists [39] reply that the testimony of the senses cannot be accepted regarding numerical identity when set aside by the evidence of reason: no medievalist taught the numerical identity of motion in moving and moved bodies after collision, and yet the senses seem to testify to the passage of the motion from the one body to the other. They also reminded their opponents of the accepted distinction regarding validity in the Aristotelian theory of sense-perception: the senses are infallible in reference to their respective proper sensibles, fallible in reference to all the common sensibles. Now the numerical identity of an accident at different times is one of the common sensibles. Were God to destroy at any moment the whiteness of a wall and instantaneously to put in its stead an exactly similar whiteness, no human eye would be aware of the change in numerical identity of this accident. Even the ordinary thimble-rigger can lead the senses of the onlookers astray on this question of numerical identity! How, then, can man be assured of the numerical identity of any part of his environment? Not by his senses alone, but by reasoning which supposes, on valid grounds, the uniformity of the divine ordinances in nature and, also, the trustworthiness in their respective spheres of sense and of intellect. Further, when challenged for an efficient cause of these disputed accidents, the Thomists appealed to the extrinsic death-dealing agent: the activity of this extrinsic cause on the living body produces the corpse-form and, with this, by way of natural resultance all the accidents of the dead body. The specific likeness of the accidents before and after death was said to be due to a certain affinity between the substantial forms of the body when alive and when shortly dead. Accidents that seem anomalous, either in reference to the corpse-form or to the extrinsic death-dealing agent, were said to be due to the union of the corpse-form with a primordial matter that has been deprived—sometimes suddenly, in all cases quite recently—of its living form: and it was added that the corpse-form, like the embryo-form, takes time to develop all its powers in its substrate.

Suarez's second objection is based on reasoning. A bodily agent can act only on an extended, corporeal patient: it is not

enough, then, that the patient be quantified during the whole process of alteration; it is necessary that this quantification should exist at the actual instant of the generation of a new substance because a new action, proceeding from a bodily agent begins at that instant, namely, the production of the substantial form. His opponents reply that primordial matter is the immediate but not the sufficient basis of generation: it must be previously prepared by suitable dispositions for the incoming substantial form; and this preparation is wrought by some natural agent. "In order that any generation may be called natural, it must be produced by a natural agent and out of natural matter that is thereto appropriate: should either of these be wanting, the generation cannot be called natural." [40] Their point is that primordial matter never exists by itself for a single instant during the whole process of substantial change: the outgoing substantial form remains with the varying accidents until the incoming substantial form with appropriate accidents takes its place. It is possible to hold, then, that in generation the patient must be corporeal and extended and yet to deny that quantity or any analogous accident persists numerically unchanged during this process. The generating cause by acting on the patient gradually alters the qualities of this patient in such a way as to dispose its primordial matter for a new substantial form: a stage is reached in this gradual alteration when these qualities are so changed as to be no longer fit properties for the elementary substantial forms; and as soon as that incompatibility is effected, the substantial form of the elements and their qualities disappear out of existence and, simultaneously, the substantial form of the true mixture is born bringing in its train those quantitative and qualitative accidents which make up the properties of the newly produced substance.

Suarez's third objection touches the most difficult point of the whole controversy: the doctrine of his opponents that, when the generating agency actually produces the new substantial form of the mixture, none of the previous dispositions which brought about the corruption of the four elements are present in that primordial matter into which as substrate this substantial form is received. To appreciate the strength of this objection the whole process of substantial change must be recalled. That process begins when circumstances of one kind or another bring together the four elements in certain proportions. Thereupon alteration sets in: due to the interaction of the four elements on one another as influenced, of course, by their environment. During the interval that precedes the eduction of the new substantial form, this alteration produces changes in the active and passive qualities of the elements which are more and more abnormal and, therefore, more and more provocative of the disappearance of the elementary substantial forms. Uncongenial and incompatible qualities of this kind that are produced prior to the instant of generation are called previous dispositions: there can

be no controversy about such dispositive accidents for they exist in and are supported by their respective elements. A moment comes, however, when the resulting incompatibility between these accidents and the existing substantial forms is so pronounced that they and the forms can no longer co-exist in the same substance. The problem is—what happens at this moment? St. Thomas and most of the Schoolmen hold that at this moment, the instant of generation, the substantial forms and all the accidental forms of the elements cease to exist. Suarez and his supporters allow that at this moment, the instant of generation, the substantial forms of the elements cease to exist, but urge that certain dispositive accidents persist in the primordial matter: they demand this persistence of these dispositive accidents on the grounds that otherwise primordial matter would not be disposed for the reception of *this* rather than *that* substantial form; and they explain the possibility of their persistence on the ground that primordial matter may be a sufficient substrate for certain accidents. The gist of the Thomist reply is that primordial matter is prepared at the instant of generation for the reception of this rather than that substantial form by certain accidents that are technically termed "ultimate dispositions." These ultimate dispositions do not exist in the four elements; neither do they exist in the primordial matter of these elements prior to the advent of the substantial form of the mixture; they are introduced into this primordial matter at the instant of generation concomitantly with the incoming substantial form; in fact, they follow by way of resultance from that new substantial form. Suarezians naturally object that qualities which follow from and after a substantial form cannot prepare a substrate for the reception of this form. Thomists insist that whether accidents inhere in primordial matter or in the complete substance, these ultimate dispositions can never exist simultaneously with the elementary forms for the simple reason that, being specifically incompatible with these forms, they expel them: "the substantial form of water is expelled by heat of the highest kind" (41)—the specific heat of fire. They insist, also, that these ultimate dispositions are, even in the Suarezian theory, introduced into the primordial matter by the incoming substantial form: "heat of the highest kind is introduced simultaneously with the form of fire." (42) In every theory, then, the ultimate dispositions exist only with the substantial form of the mixture. But the difficulty of St. Thomas and his supporters is to explain how such ultimate dispositions can be said to prepare primordial matter for the reception of a particular form. St. Thomas's explanation is that these ultimate dispositions precede materially the incoming form. The ultimate disposition is the effect of the incoming substantial form from the point of view of formal causality, and yet it precedes this latter form from the point of view of material causality. "The like happens in natural bodies with reference to that disposition which is necessary for a form: that disposition

in one sense precedes (substantial) form, namely from the point of view of material causality, for material dispositions refer to matter: but in another sense, namely from the point of view of formal causality, the substantial form comes first for it perfects both primordial matter and the material accidents." . . . "Another kind of disposition prepares something for its form: for instance, it prepares primordial matter for the reception of its form in such a way that it pre-exists in matter before the form does, not in the order of existence but in the order of production: heat, for example, acts as a disposition for the form of fire, not because it intervenes as intermediary between substantial form and primordial matter but because primordial matter becomes possessed of the form of fire by means of the advent of heat." (43) St. Thomas adds that these ultimate dispositions exercise no efficient causality on the form. "This disposition does nothing for the form efficiently: its action is purely material and consists in the fact that primordial matter is by means of this disposition rendered fit for the reception of the form. . . . More dispositions are necessary for the removal of contrary forms and the introduction of a form than for the mere introduction of a form." (44) All this is explicit, but, when later controversies arose, the difficulty of those who endorsed St. Thomas's view lay in pointing out the linkage between the accidents of the four elements that perish at the instant of generation and the accidents of the true mixture that at the same instant take their place. The general answer was that the accidents of the true mixture are the term and the consummation of all preceding accidents: whatever be the generating agency at work, the ultimate dispositions are in the circumstances the necessary sequel of all the previous dispositions, "heat of the eighth degree (the property of fire) is of the same nature and species as that heat of the sixth or seventh degree which, prior to the instant of generation, disposes wood for the substantial form of fire, and in this way the ultimate disposition is the term and consummation of the (antecedently dispositive) heat." (45) It was usual, also, to look on the ultimate dispositions as forming with all previous dispositions a single dispositive material cause on the plea that the same instant which marked the death of the latter set of dispositions marked the birth of the former set: "just as a thing may be said to be produced at that instant in which it exists for first time for the reason that this particular instant, which is the term of the time occupied in producing the thing, gathers up into itself whatever was accomplished during the preceding moments." (46)

The final objection of Suarez is based upon the hylemorphic theory of man. He asks how can a spiritual soul be informed by quantity; and concluding that this is impossible, he lays down that, at least in man, primordial matter must be the subject of quantity and of analogous material accidents. But if this must happen with regard to man, he urges that it may happen in all

other substances. The Thomists retort that the human soul is the subject neither of inhesion nor of receptivity in regard to material accidents: that its function is to actuate primordial matter and thereby constitute a complete human being; and that there is little difficulty in explaining how a spiritual soul can be one of the two constituent principles of a substance that has corporeal accidents. Their argument is that quantity, being an accident, lies outside the essence of every kind of body: it emerges simply as a necessary concomitant of corporeal substance—inherent in but extraneous to, and logically subsequent to, the formation of this latter. And they insisted that a higher substantial form can accomplish by virtue of its greater perfection everything which can be done by a lower substantial form: hence, the human soul can give being and corporeity and life and sentiency as well as reason; but whereas reason inheres in the soul alone, all those other powers inhere in the composite of soul and body and owe their origin not to the fact that the soul is spiritual but to the fact the soul is the substantial form of man, a corporeal being. No substantial form has, of itself, quantity: but if the lower substantial forms can introduce this and other material accidents into the composite which they form by uniting with primordial matter, why should not the highest kind of substantial form in terrestrial beings be able to do at least as much? "A more perfect form virtually contains whatever is proper to inferior forms: that is why it, although remaining one and the same, endows matter with different degrees of perfection. Thus it is essentially one and the same form by which a man is actual being; by which he is body, by which he is living, by which he is animal, and by which he is man. Now it is plain that the appropriate accidents accompany each grade of being. And as matter is thought of as perfected in being before being thought of as perfected in corporeity—and so on for the other degrees of perfection—similarly, the accidents appropriate to being are thought of as present prior to those appropriate to corporeity." (47) "One form, for instance, constitutes matter merely as a body. . . . But another more perfect form constitutes matter not merely as a body but also as a living being. Again, another form gives, in addition to corporeity and life, sentient being; and so on. . . . Now matter when regarded as substantially complete in being according to the standards of any inferior grade, can, in consequence, be regarded as subject to accidents. For substance of that lower grade of perfect must necessarily have accidents proper to itself and necessarily inhering in it. . . . Hence it is that since the human soul is a substantial form and constitutes man in a definite species of substance no other form intervenes between this soul and primordial matter: man is completed by the rational soul and by it alone in his various degrees of perfection, to wit, body, living being, rational animal." (48) "In so far as the human soul surpasses the perfection of corporeal matter

and is capable of subsisting alone and of energising alone, it is a spiritual substance ; but in so far as it is brought into contact with and communicates being to matter, it is the form of the body." (49) "A second opinion lays down that there can be only one substantial form in each individual ; and in accordance with this, it follows that each individual owes to that substantial form which is human the possession not merely of reason but also of sentiency, life, corporeity, substance and being. Hence no other substantial form precedes in such a man his human soul and, consequently, no accidental form precedes : for in this last hypothesis, one would have to admit that matter was perfected by an accidental form prior to the substantial form : a view utterly inadmissible since every kind of accidental reality must be based on a substance." (50) "No accident can survive the destruction of its subject. Hence when the composite (human substance) is corrupted, these powers (of sentiency and nutrition) do not remain actually : they remain only virtually in the soul as in their principle or root." (51) "Those faculties are said to remain in the disembodied soul as in their root : not that they are actually in it but that the separated soul has the power, if it be united (again) with the body of causing these faculties in that body just as (it would again cause) life." (52)

On the totally different question as to whether one accident can naturally be the ultimate subject of inhesion for another accident, St. Thomas and Scotus and Suarez were of one mind : one accident cannot be the ultimate subject of inhesion for another. Thomist and Scotist and Suarezian allowed, however, that one accident may sometimes be prior to another in its reception into its ultimate substrate. (53) They appealed confidently to facts of experience : heat is received into a body through its surface ; colour, rarity, density and figure are quantitatively diffused through bodies. They appealed, also, to the state of existence of the sensible qualities of consecrated bread and wine : the substances have disappeared, yet these sensible qualities persist ; unless one insists, then, on the multiplication of miracles, the natural conclusion is that these qualities are sustained by the quantity. "It must be held to be necessary," writes St. Thomas,(54) "that the other accidents which remain in this Sacrament, should subsist as in a subject in the dimensive quantity which remains of the bread or of the wine." Scotists and Suarezians interpreted this teaching about the priority of quantity as implying that quantity received into itself these other accidents, terminating, thereby, proximately their inherence and their subsistence : in short, that quantity was a proximate subject of these other accidents. The Thomists refused to admit that quantity was a proximate subject of this kind : they held quantity to be a necessary link by which these other accidents inhere in and are sustained by their connatural substance ; in short, these other accidents are not truly inherent in or truly sustained by quantity.

The Nature of Substantial Form.

Aristotle had sufficiently unfolded the nature of substantial form as the first actuality of primordial matter which, by union with the latter, forms a complete essence. The Schoolmen had nothing to add to this portion of his doctrine: and we shall find them emphasising that rôle of the form again and again in this and the next chapter. In consequence of that rôle, they spoke of primordial matter and of substantial form as, each of them, an incomplete substance: an expression which is to be understood, Cajetan says, only *reductive*.[55]

But, for reasons peculiar to their age, they were more explicit than Aristotle on the distinction between the substantial form and accidental active principles. Centuries before Aristotelianism had become the dominant philosophy of the Church, theologians had developed a theory about the appearances of consecrated bread and wine which implied that body as substance was not an object of sense-perception. In those days, every theologian was a philosopher and every philosopher a theologian. The result was that the Schoolmen, denying on theological grounds the perception of material substance, denied also the perception of substantial form, one of the constituents of substance. As philosophers, however, they brought forward two arguments distinct from that based on the current theology of the Eucharist: one of these was due to St. Thomas, the other was due to Suarez.[56] St. Thomas's argument is based on the intimate relation between any potency and its appropriate actuality: diverse actualities necessarily presuppose a diversity of proximate potencies. Now, the actions of an inanimate substance and the existence of that substance are totally different facts: its actions are many and fleeting, its existence unique and relatively permanent. Anyone of the four elements has a variety of actions but it has only one existence: further, that existence continues even when this element is not exercising one or other of its activities. It is one thing for fire to cause heat, it is another and quite a distinct thing for fire to exist: but to cause heat is the actualisation of the heating power of fire, and to exist is the actualisation of the essence of fire; consequently, the heating power and the essence are different realities. And what is true of the heating power is true of every other active principle in fire or in any other non-living substance. In inanimate substances, no principle of activity is identical with the essence. Substantial form is, however, part of the essence. Therefore, the active powers of non-living substances cannot be identical with the substantial form. Substantial form is indeed the root of these active powers: but it is not identical with these immediate principles of activity; it is their hidden source. Suarez reaches the same conclusion by a different route. His starting-point is that each non-living substance has a distinctive set of specific properties: a stable group of qualities which are quantitatively

definite and are inseparably connected with this species of body, and, thus, easily distinguishable from those other transient qualities that continually come and go without changing the body's specific nature. Inseparable qualities of this kind, common to all members of the species and never present in this definite quantity as a group in members of other species are called—in the strict sense—properties. There must be some unifying principle to account for this unitary grouping of specific qualities in individual substances. No such principle of unity is discoverable in the properties themselves : as a matter of fact, each of these qualities is present, in different amount and with different companions, in bodies of other species. Primordial matter, being itself a passive potency, could not exercise the task of unifying this group of active properties. Therefore, substantial form must be the inner bond of association among themselves of the specific properties. It is, then, a principle distinct from and more fundamental than the properties of bodies. These latter are perceptible : it is not. On these grounds, then, the medieval theory of the imperceptibility of substantial form was based. The existing individual—in the non-living world—is the agent that acts : action is a development of existence and cannot be realised apart from existence. But only a complete essence is capable of complete existence, and in that essence while substantial form is the mediate and remote principle of activity, the properties which are accidental forms are the immediate and proximate principles of specific activity. Substantial form is a remote, regulative principle which determines the specific nature and extent of any body's activity.

The Unicity of Substantial Form in Non-living Bodies.

Difference of opinion concerning the inner structure of inanimate true mixtures led to a controversy as to the unicity or plurality of substantial form in inanimate bodies. Aristotle had taught that inanimate bodies were a blend in varying proportions of the four elements. But he seems never to have reached a definite conclusion on the permanence or non-permanence of the substantial forms of the elements in these composites. His text when treating directly this problem favours the theory of their non-permanence : other texts of his favour the theory of their permanence.(57) Accordingly, the medievalists in interpreting these texts took different sides : some defending the permanence of the substantial forms of the elements in true mixtures, others defending the contrary view. Avicenna, Averroes and Albertus Magnus defended the theory of permanence.(58) Avicenna held that the substantial form persists in its full perfection. Averroes held that it persists in a weakly state : his presupposition is that the substantial forms of the four elements are, on account of their imperfection, middle terms between accidental forms and all other substantial forms, and that they can exist, therefore,

in a state of greater or less intensity somewhat like the accidental forms. Albertus Magnus attempted a further compromise. His starting-point is a peculiar distinction in non-living bodies between apparent mixture and true mixture and generation or corruption of substance; an apparent mixture has not homogeneous parts; a true mixture has homogeneous parts but does involve as complete a change of substance in its components as does either generation or corruption; generation or corruption imply a complete change of substance. A true mixture is a new homogeneous substance arising out of the alteration of the four elements: it is neither fire, nor earth, nor air, nor water but a distinct substance with a corresponding substantial form; moreover, it is a distinct substance which is through and through homogeneous; still, it is a distinct substance that holds within itself both the essence and the properties of the four elements. As regards the fate of the substantial forms of the elements in such a mixture, Albertus holds these are neither wholly preserved nor wholly destroyed: not wholly preserved, because the same primordial matter cannot be simultaneously actuated by more than one substantial form; not wholly destroyed, because this kind of mixture certainly possesses the properties of the four elements. In defence of this view, Albertus distinguishes two kinds of substantial form in the elements: a primary substantial form which gives substantial being; a secondary substantial form which gives existence and activity. When the elements unite in a true mixture, this secondary form disappears but the primary persists: and as these primary substantial forms are of themselves incomplete, they not only do not exclude but actually need a new substantial form in the true mixture. This Albertine theory was accepted by a few Schoolmen.(59) It was acquiesced in for a time by his pupil, St. Thomas. St. Thomas changed his mind later on and initiated, in the teeth of grave opposition, the theory of unicity of substantial form in all substances including inanimate true mixtures.(60)

The fundamental basis of St. Thomas's theory of unicity is that a mixture in which the substantial forms of the elements persist can not be said to be true: "if (61) a mixture is found in which the elementary substantial forms persist, it cannot be true, it must be apparent and due merely to the juxtaposition of imperceptibly small particles"; "moreover what seems a (true) mixture to one whose eyes do not enable him to distinguish these parts is known by one with keener eyes not to be a true mixture"; "the different portions of matter as long as substantial forms of the elements remain, are really so many distinct bodies." St. Thomas's next point is that the suggestion of increase or decrease in the reality of substantial form is absurd: as the specific substantiality of any body is indivisible, addition or subtraction would involve a change of species just as in numbers; a hybrid form—partly substantial and partly accidental—is impossible because the substantial form is presupposed by the composite

and the accidental form presupposes the composite. He concludes, then, that a new solution must be sought: "we must discover some other solution by means of which the meaning of the true mixture is kept intact, and at the same time the obvious fact, that elements are not completely destroyed but are somehow preserved in the true mixture, is acknowledged." (62) This new way of thinking is set forth in detail in the Opuscule, *De Mixtione Elementorum*. "A mutual contrariety and difference of intensity exist between the active and passive qualities: out of differences of this nature between qualities, a medium quality which shares the nature of its extremes can be formed, for instance, pale is a mean between black and white, tepid between hot and cold; and in this way the elementary qualities when toned down (by interaction), form a mean quality which is characteristic of the true mixture as such; this mean quality is different in different mixtures owing to the different proportions in each mixture of the elements." And as a result of the necessary connexion between the substantial form and the specific properties of any substance, this abnormal change of the specific properties of the elements involves the disappearance of their respective substantial forms: "a body cannot lose its qualities unless it itself be destroyed; heat can be taken from fire, for instance, only by the corruption of fire," "this (mean) quality is the disposition for the substantial form of the true mixture just as the elementary quality is that of the elementary form." Moreover, as long as the true mixture exists its "contrary qualities are controlled and are preserved from the work of mutual destruction by its substantial form." If this equilibrium is sufficiently upset by an external cause, then, the true mixture breaks down once more into the four elements: each of the four reappearing with its proper qualities. The principal cause of this breakdown is the substantial form of the mixture acting through the mean quality: "in true mixtures there exists an active principle of corruption owing to the fact that it is built up out of contraries." This destructive activity of the substantial form is conditioned, of course, by the environment, immediate and remote: "if this (the activity of the heavenly bodies) were to cease, the activity of all terrestrial bodies would cease." (63) St. Thomas concludes, then, that the substantial forms of the elements do not persist actually in true mixtures: "we must hold with the Philosopher that the forms of the elements remain in the composite, not actually, but virtually." (64) This virtual presence means merely that the qualities of the elements recur in the mixture tempered by their previous mutual reaction and actuated by the new substantial form, that of the mixture: "for the qualities proper to the elements persist and they contain the efficacy of the elementary forms: and this (mean) quality of the mixture is the proper disposition for the substantial form of the mixture, for the form, v.g. of a stone or a living body." "Whenever a true mixture is formed from constituents that differ in quality either because

their qualities are contrary or because their qualities, though the same, are of different degrees of purity, then, once the mixture is complete, neither constituent is therein with its own proper quality: for if it were, the result would simply be a collection of unchanged substances, in short only an apparent mixture: hence the whole must receive a single form which is a mean." [65] These extracts contain an outline both of St. Thomas's criticism of the opposing view and of his reasons for the unicity of form in non-living bodies. He mentions as opponents Avicenna and Averroes: he does not mention Albertus Magnus, but no doubt can be entertained by an attentive reader as to St. Thomas's attitude towards his master's theory. Subsequently, some of the Schoolmen sided here with Albertus Magnus. But Henry of Ghent, Scotus and Suarez sided with St. Thomas—in reference to inanimate substances—and brought with them the overwhelming majority of the Schoolmen.[66]

The Simplicity of the Substantial Forms of Non-living Bodies.

The School attributed various kinds of simplicity to the substantial form of non-living substances. Substantial form is simple in the sense of being unanalysable; as one of the ultimate principles of substance, it cannot be broken up into anything more fundamental. Substantial form is simple in the sense that it confers on every part of a body the same essence: it communicates the same specific essence to the whole and to each part of the substance. "The whole substantial [67] form of wood is in every part of it: because the totality of a substantial form does not admit of quantitative totality, as is the case with the totality of accidental forms which are founded on quantity and presuppose it." Finally, substantial form is simple in the sense of being of itself devoid of quantity: it is not of itself extended in space. "It is [68] the composite which has diverse parts. Hence diversity of parts does not belong to the matter or the form but to the composite." But this third kind of simplicity was affected by that complete immersion in matter which is the fate of the substantial forms of non-living bodies. The Schoolmen, having rejected the Democritean atom, were committed to the theory that every sensibly unbroken body was a single substance: a stone, a stick, a bar of iron, a block of marble, a river, an ocean—whatever their respective sizes. Now, if every sensibly continuous molar bulk was a single substance, it was actualised by a single substantial form: at least in non-living bodies. Experience shows, however, that these larger non-living substances are being frequently broken up into smaller substances of the same species: for instance, sticks into splinters, stones into fragments. This division is effected by mechanical means: none of the processes of alteration occur prior to the resulting divisions; and these results themselves betray no sign

of a change of substance. The Schoolmen drew from these facts of experience the conclusion that the substantial form of non-living substance was divided consequent on the division, up to a certain limit, of that substance itself. And they termed this divisibility of substantial form incidental in order to emphasise their view, that this divisibility was alien to the nature of form and arose solely out of its complete immersion in matter. "Matter (69) and form have not parts of themselves, they have parts merely incidentally : hence they are divided merely incidentally, that is, owing to the division of the whole." "When a line is divided there is no new reality in the divided parts but that same linear essence which was previously one in actuality and multiple in potency is made by division multiple in actuality. . . . Exactly the same thing occurs in stone and in fire and in all non-living bodies that are generable and corruptible : for that form, owing to which they have unity of nature side by side with unity of quantity, is present in all its perfection in every part of such substances. The result is that when these bodies are split up the essence of the same form remains in the separated parts : each part of the fire is (when separated) a fire, each part of a stone is (when broken off) a stone. . ." "This (divisible) totality can be attributed to forms only incidentally inasmuch as they are incidentally divided by a division of the quantity : as, for instance, whiteness by division of the surface. But this (incidental division and subjection to quantitative totality) is found only in those forms that are coextended with matter : and this coextension is due to the fact that such forms have similar matter in the whole as in the parts."

The Origin of Substantial Form.

The Schoolmen held that in the beginning God created certain material substances and, with these, their substantial forms. But the subsequent perpetually recurring changes of substance involve a production of a new substantial form for each newly produced substance. The question arose, then : whence come these newly produced substantial forms ? Aristotle (70) illustrated this question by reference to the production of works of art : the substantial form is developed in primordial matter by the action of the generating cause in the same way as the shape of a statue is developed in wood or marble by the activity of the sculptor ; the only difference being, that this shape existed previously merely in the mind of the sculptor while each newly made substantial form is received by its substance from a pre-existing material substance. St. Augustine crystallised this doctrine in the famous formula : form is educed from the potency of matter. The great value of this formula to his mind was its marking off of finite propagation from creation : creation, the work of God, is the making of something out of nothing ; propagation, the work of finite beings, is the making of something

out of the potency of a pre-existing substrate. Pithy formulæ lend themselves to various interpretations. In his own day, St. Thomas (71) was confronted with three unsatisfactory interpretations: that of Anaxagoras, involving the latent pre-existence from eternity of all substantial forms; that of Plato, attributing the origin of such forms to the action of the Ideas; that of Avicenna, referring their origin to the activity of finite spirits, the Intelligences. Anaxagoras got short shrift: his theory would make substantial change an illusion, and would postulate in the first created bodies countless multitudes of forms, hidden as in a conjuror's box and awaiting there the appropriate moment for their emergence. St. Thomas rejects also the supposition on which the theories of Plato and Avicenna are based: to wit, that material agents merely prepare primordial matter for the reception of a form which is produced by an immaterial being—the Idea or the Intelligence. "They (Platonists and Avicenna) appear to have been led into this error because they considered a form to be something produced in itself: so that it must proceed from some formal principle. But—as the Philosopher proves in the seventh Book of the *Metaphysics*—that which is, properly speaking, produced is the composite. For it alone, strictly speaking, exists, inasmuch as it is subsistent. But the form is not called being in the sense of that which exists by itself, but in the sense of that by which something exists. The consequence is that the form is not, strictly speaking, produced: production pertains only to that which has a being of its own because production is nothing else but a making of being. Further, it is clear that the thing made bears a likeness to its maker: because every agent produces an effect like to itself. Wherefore, that which produces natural things bears a likeness to the composite: either because it is itself a composite as when fire generates fire; or because the whole composite, both as regards matter and as regards form, is virtually contained in the agent—which belongs to God alone. Therefore all information of matter is immediately due either to God or to some bodily agent, and not immediately to Angels." (72) "These theories (of Plato and Avicenna) deny that natural power which exists in every natural principle of producing its like so far as the substrate on which it acts is capable of receiving this like. And this power follows from the fact every agent acts up to its own actuality. Therefore whatever is actualised in a particular way can after a fashion produce this actuality: accordingly, every natural principle is intended to reproduce itself by its own actuality." (73) In short, St. Thomas contends that two errors underlay this doctrine of Plato and of Avicenna: by maximising the nature of material substantial forms, they unfitted these forms for their purpose of actualising material substances; by minimising the generative powers of material substances, they denied the very purpose of the existence of such substances. "The third opinion, that of Aristotle, is a mean between these

(the opinions of Anaxagoras, Plato and Avicenna): according to it, all forms are in potency in primordial matter—not, as is said by the defenders of latent forms, actually; and according to it, the natural agent by reducing matter from potency to actuality produces, not the form, but the composite. This natural agent is in its activity a kind of instrument of that God who both made matter and gave it its potency to form. Therefore, in this theory, there is no need to hold that the generating cause creates the form or makes something out of nothing: because he produces, not the form, but the composite." (74) And to those objectors who stressed the point that substantial forms were new realities and must, therefore, be created anew each time, St. Thomas retorted that accidental forms were also new realities and that the logical consequence of this line of argument was Occasionalism. "If for these reasons, it be necessary to resort to creation in order to account for the origin of substantial forms, the same reasoning would be equally valid in the case of accidental forms. For just as the substantial form perfects a substance at the moment of origin, so the accidental form adds a reality to the substance already made. Consequently a natural agent would be in no sense a generating cause, neither by perfecting nor by disposing, and this would involve the utter denial of all natural activity. For when a thing is said to be made out of nothing this means a denial of any material substrate: but a material cause can never be absent from either substantial or accidental generation." (75)

There were, however, other dissentients (76) besides Anaxagoras, Plato and Avicenna. Soto attributes to Albertus Magnus the view that all forms pre-exist in an undeveloped state in primordial matter. This suggestion was set aside as multiplying rather than solving the difficulties of eduction: substantial forms differ from one another as do the cardinal numbers, and consequently to speak of them as existing in an incomplete stage is absurd; moreover, even were this inchoateness thinkable, the genuine difficulty of eduction recurs in explaining the progress from rudimentary to finished substantial form. Durandus mentions without names authors who tried to cut the Gordian knot by inserting in primordial matter certain possibilities of substantial forms. Soto attributes to Auriolus the suggestion that the form partly pre-exists in primordial matter and is subsequently made perfect by the action of the generating cause, and, thus, is not a production from nothingness. These suggestions won little support. If the alleged possibilities imply merely the potency of matter, that particular view differs merely in words from the general teaching of the Schoolmen. But if this alleged possibility and this alleged partial pre-existence are really intended to relieve the seeming mystery of eduction, they necessarily imply the presence in primordial matter of some reality other than itself. Now, every thinkable interpretation of that reality is open to serious objection: that reality cannot be an accident,

for an accident is useless to explain the emergence of a substantial form: that reality cannot be either a full-blown substance or any of the two constituents of substance—not the coming composite for *ex hypothesi* it does not exist at this stage of the process, not primordial matter, for *ex hypothesi* this reality is something added to primordial matter, not the full substantial form for *ex hypothesi* it is only in the making so far; this reality must, then, be nothing else than an inchoate stage of the substantial form—a revival of the inadmissible view fathered on Albertus Magnus. The uselessness of all these attempts to escape from the mystery of eduction confirmed the majority of the Schoolmen of the wisdom of subscribing boldly to the Augustinian formula and of explaining definitely its meaning.

The eduction of substantial form out of the potency of the primordial matter has a negative and a positive aspect. Negatively considered, eduction implies that the form is not so much an entity itself as the cause of entity in another; that the form, by reason of its imperfect entity, cannot be the total effect of either creation or production; that the form must be developed out of some reality; and that it cannot continue in existence by itself but requires the support of another reality as substrate. Positively considered, eduction implies that primordial matter has priority of nature in respect to form in the genesis of material substance; that primordial matter is the source from which the form springs, because the latter is the substantial actuality of the former; that the primordial matter virtually contains the form; that primordial matter is the substrate of the form and absolutely necessary to its existence. "A clearer grasp of this eduction from the potency of matter is available by the exposition of the five characteristics of all forms which are produced in this way: firstly, these forms are produced through material dispositions wrought by the actions of material agents, that is, by dispositions, actions, and agents which are inherent in and intrinsically united with matter; secondly, these forms depend in their very production upon matter, that is, they can be begotten only within it and only in union with it, they are not produced as independent realities, and afterwards extrinsically attached and united to it; thirdly, these forms depend for their existence on matter because outside that matter in which they were originally produced, they cannot exist for an instant either as self-subsisting realities or even (as co-principles) in distinct matter—for them, separation from that particular matter involves loss of existence; fourthly, these forms depend in their activities upon matter, with the result that the activities of such forms do not inhere in the form but in the composite as their subject; fifthly, these forms depend on matter for their essence in the sense that they can neither be defined nor fully understood except in reference to it. These five implications, then, are conveyed in the doctrine that forms are material and are educed out of the potency of matter." (77) Valuable

as are these implications as giving a solid meaning to eduction, they leave untouched the real difficulty—whence come the new forms? The answer seems to lie in the mystery of causality: a cause may give what it has. In other words, the stock phrase about eduction from potency is—as a result of the actual controversies waged over the origin of these lower forms—incomplete. Attention must be fixed on the active power of the generating cause. The generating cause reproduces its like in the patient: and under suitable conditions, a new substantial form is one of those realities that is realisable in primordial matter: realisable therein with a dependency which effects its origin, its existence and its maintenance.(78)

The exact nature of the efficient cause of substantial forms led, however, to differences of opinion. Actions belong, in the technical language of the School, to the supposit, that is, to the existing inanimate individual. Now an existing inanimate individual contains several realities: primordial matter and substantial form, essence and properties and accidents, and the existence of all these. Hence a controversy arose as to whether the faculties, i.e. the accidental forms, were capable of producing a substantial form. St. Thomas and the Thomists held that they were thus capable: their view being that, strictly speaking, accidental forms are in finite substances the sole immediate principles of action. Thomists teach that the existence of the faculties results from the existence of their connatural subject: "the actuality of the accidental cause is caused by the actuality of its subject." (79) This subject, considered as abstractly possible, implies those accidental forms which are as properties, its natural complement, and it cannot exist, therefore, without simultaneously communicating existence to these properties; "the subject is, in potency, susceptive of the accidental form and is, in actuality, productive of it." St. Thomas denies, however, that this causality between the essence and its properties is efficient: he admits that this causality is in a sense active; (80) the essence by natural resultance being the scource of the existence and of the nature of these properties. Starting from this basis, the Thomists hold that the substance of finite beings, considered in itself and in opposition to the faculties, exercises no activity of its own. What would be the need of active faculties if the finite substance itself could act? These faculties are the natural sources of action in each finite body: the proximate and immediate cause of all that body's activities. Abstractly considered, then, the faculty alone for the Thomists is active and is the source of productive power: the essence is merely the ultimate root of activity; the substantial form is a principle of activity merely in the sense that its nature determines the kind of specific properties which emanate from the essence. Concretely, things are otherwise for the Thomist: the faculty owes its existence to that of the substance, for a single existence actualises both—first, the substance and through it the faculty. Now, the faculty

must exist before it can act and, therefore, the subject concurs in what is fundamental for the action of the faculty. If there were no subject there would be no faculty, and, that is why all activity belongs not to the faculty alone but to the existing individual.

Applying to our present topic this doctrine of theirs concerning the source of activity in finite substances, St. Thomas and his disciples taught that the accidental forms are the proximate and immediate causes of all newly produced material substantial forms. "The (81) change which has a substantial form for its term is not produced immediately by the substantial form, but by means of active and passive qualities which act by virtue of the substantial form." "The accidental form owes to the substantial form the fact that it is a principle of action: hence the substantial form is the primary, but not the proximate, principle of action." "Substantial forms are not the immediate principles of action in natural actions: they act through active and passive qualities as their proper instruments. . . . And thus qualities act not merely through their own power but through the power of the substantial form. That is the reason why their action results not merely in an accidental form but also in a substantial form: in short, that is why generation is the term of alteration. But they participate in this kind of instrumental power for the very reason that they are caused by the essential principles." "The efficient cause admits of a twofold division. One division occurs from the point of view of the effect: namely, into a disposing (cause) which produces the disposition for the ultimate form, and perfecting (cause) which produces the ultimate perfection. The second division occurs within the cause itself and shows itself as principal and instrumental agent. The principle agent is the first mover: the instrumental agent is a moved mover. But every instrument has a twofold action: one proper to itself and another which it receives from the principal agent. . . . It must be remembered that the action of the instrument extends to the ultimate perfection which the principle agent can effect but sometimes does not: in all cases, however, this action extends to something beyond that which the instrument could of itself achieve, whether that something be the ultimate form or disposition. For instance, the active and passive qualities of the elements extend instrumentally to the eduction of material forms from matter." "Thus an instrument has two kinds of activity: one which lies within the competency of its own form; and another which lies within the competency of this instrument when moved by an agent that surpasses the power of its own form." "An active quality, like heat, although it is an accident, acts by virtue of the substantial form, however, and as its instrument, and that is why it can produce a substantial form. . . . Nor is it contrary to the nature of an accident to exceed its subject in action: but it would be to exceed this subject in being." "The active qualities act in virtue of the substantial forms: and

in consequence a natural agent produces his like, not merely in quality but in species." "A body acts towards the production both of an accidental and of a substantial form. For the active quality of heat, even though it is only an accident, acts in virtue of the substantial form and as the instrument; that is why it can act towards the production of substantial form. For instance, natural heat, inasmuch as it is the instrument of the soul, leads to the generation of the flesh: but it leads to the generation of accidents by its own power." "The action of an accidental form depends upon the action of the substantial form in the same way as the being of an accident depends upon the being of substance." "It is to the substantial form that the accidental form owes the fact of its being a principle of action, and, therefore, the substantial form is the primary, but not the proximate, principle of action." These and similar texts are the basis of the Thomist view. The upshot of that view is that a created substance can never be an immediate principle of activity. "Activity is identical with substance only in God. And that is why the power which is in God the principle of activity is the very essence of God: but the like cannot happen in the case of soul or of any other creature." (82) In consequence, Thomists are committed to the theory that the accidental form, which is united with the substantial form in a manner that does not imply the reception of any power from this form, can produce not merely forms which are like itself—namely, accidental forms—but also a form that is higher than itself, the substantial form.

Scotus (83) and his disciples fastened on this anomaly. "An instrumental form of itself and without any actual influence from the principal form," urges Suarez, repeating the main contention of Scotus, "cannot be a sufficient proximate cause of the production of a higher form. This principle seems to me to be manifest almost from its very terms; for, if the lower form is not actually aided by the higher, it works only by what it actually has in itself; and since this is an entity of a lower order, it can never of itself produce anything more perfect." And the Scotists concluded that an accident cannot produce a substantial form either as principal or instrumental agent: accidental forms can prepare a body for the reception of a new substantial form by producing therein certain pre-disposing qualities; but these accidental qualities cannot produce the incoming substantial form. In reply to this objection of the Scotists, the Thomists urge the already quoted texts of St. Thomas. The value of these texts as a reply depends on the perpetually recurring phrase: *in virtue formæ substantialis.* But Cajetan and all the Thomists insist that this phrase does not connote the giving of any power by the substantial form to the active qualities. And in that case, the Scotist objection remains unanswered. Suarez suggests that this phrase of St. Thomas might be reasonably interpreted as implying, at the moment of substantial change, a real aiding of the active qualities by the substantial form. This

suggestion seems to meet the point of the Scotist objection: the production of the new substantial form is the effect of the immediate action of both kinds of form, the action of the substantial form as principal agent, the action of the qualities as instrumental agents. Suarez admits, then, that accidental forms may be instrumental causes in the proximate and direct production of a substantial form: otherwise, in those instances where the substance is not actually present—instances that the medievalists believed to be frequent—you can give no philosophical explanation of natural facts except you adopt for these instances a theory of Occasionalism. He refuses to admit any special difficulty in this suggestion of the active influence of a substantial form: accidental forms are universally admitted to be active because this theory is necessary to explain the facts of everyday causality; why, then, not admit the activity of substantial forms in regard to those facts that cannot be explained without it except one falls back on the theory of Occasionalism? He urges with Scotus that if an accidental form can produce its like, why may not a substantial form also produce its like? and that if finite substance is of itself utterly inactive, it is a remote principle of action only in the vicarious sense that its powerlessness is supplemented by that of its active accidents. Scotists argue against Suarez that if the substantial form is proximately active in the production of new substantial forms, there seems to be no need at that moment for the activity of accidental forms. Suarez replies that this activity of the accidents seems to be necessary for many reasons: in certain instances, substantial forms are generated even though no substance is immediately present: substantial form is never of itself a sufficient principle of action because it is an indifferent and quite general principle—and just as an incoming substantial form postulates preparatory accidental dispositions, so any substantial form requires for its activity the accompanying stimulus of accidental forms as its instruments. He sets little value on the Thomist objection that the purpose of the faculties as principles of action is endangered by his admission of the activity of finite substance: alteration is carried out by these faculties; it is only when their power obviously fails us that the activity of finite substance is admitted for the purpose of avoiding Occasionalism. And though Suarez admits, in the conditions specified, the activity of the finite substance, he and his make abundantly clear that this activity of finite substance affects the inviolate supremacy of divine activity as little as does the activity of finite accidents.

A word about the medieval explanation of the disappearance of substantial form. At the beginning, substantial form was concreated with primordial matter in the first substances produced by God: ever since, substantial form has been educed from the potency of primordial matter by the action of finite agents. "Form can be considered in two ways: in one way as existing in potency—and in this way it is concreated with matter by God

apart from all intervening and disposing action of nature; in another way as existing in actuality—and in this way it is not created but is educed from the potency of matter by a natural agent." (84) Thus once form was concreated, its subsequent appearances and disappearances were spoken of by the School as exits out of or entrances into the potency of matter. "Matter, then, in itself must be regarded as in potency to the forms of all those beings of which it is the common matter. Each particular form does not make it actual save as regards that particular form. And, therefore, it remains in potency with regard to all other forms. And this further potency is not excluded by the fact that one of these forms is more perfect and virtually contains in itself the others because potency, considered in itself, is equally indifferent to the perfect and to the imperfect. And that is why that just as when it is under an imperfect form it is in potency to a perfect form, so when it is under a perfect form it is in potency to an imperfect form." "Although forms and accidents do not possess matter as part of themselves they have matter in which they exist and out of the potency of which they are educed. Therefore even when they cease to exist, they are not completely annihilated but remain, as heretofore, in the potency of matter." (85) The Schoolmen taught, then, that substantial forms pass out of existence by receding into the potency of primordial matter. The substantial form is not corrupted: the substance alone is corrupted and, when it is corrupted, the substantial form disappears. But its disappearance is not annihilation for the same reason that its appearance is not either creation or production: the composite alone is created or produced. The disappearance of the substantial form is simply its recession into the potency of matter: it is no longer actually existing, but it is in matter in such a way that, on the recurrence of the appropriate circumstances, it can be educed therefrom by natural agents.

CHAPTER VI.

A MEDIEVAL METAPHYSICAL AUDIT OF THE INANIMATE INDIVIDUAL.

The union of primordial matter and substantial form results in the formation of a single essence that belongs to a determinate species. Primordial matter and substantial form are so intermingled that the form takes complete possession of the matter and that the matter receives into all parts of itself the form; and from this total compenetration arises a single specific essence which is capable of becoming a unitary nature, that is, an indivisible source of specific properties and activities. This unit of self-subsisting being can as a whole exist and act for itself: it is, in short, an existing individual. The union which produces this individual is not, however, an instance of efficient causality: an efficient cause is distinct from its effect, but the specific essence is not distinct from its two constituent principles. Neither is this union hypostatic: the constituent principles of substance have not distinct properties and distinct activities. It is an intrinsic union and, thereby, different from all artificial unions wherein realities are held together by some extrinsic bond and merely coalesce in their diverse activities. But the attempt to elucidate the varying phases of this union from the formation of the essence up to the finished product of the inanimate individual launched the Schoolmen on many subtle controversies. A cursory sketch of the more important of these controversies will enable us to realise the developments wrought in this portion of Aristotelian Cosmology by his medieval disciples.

Primordial Matter and the Essence.

Aristotle's theory of substantial form was, apart from the embodiment of these forms in the objects of experience, largely Platonic. It is not surprising, then, to find him laying down in certain texts that the substantial form was the quiddity of the composite substance, and that composite substances are distinguished solely by their forms. Averroes made these texts his guiding principles, and held that primordial matter was not a part of the essence of substance: he was supported in this view by Jandunus, Albertinus, Zimara, and Pereira.(1) Durandus

compromised : he allowed, in the abstract, that primordial matter was part of the essence, but he denied that the particular portion of primordial matter in each composite was part of the essence of that composite. The Master of the Sentences compromised, also, but in a different fashion : he admitted that primordial matter was part of the essence of all non-living substances ; but being puzzled by the ceaseless changes in living bodies, he held that only the portion of the primordial matter which came to the progeny from the parent was part of the essence of a living composite ; his argument in favour of this view was that, if all the food which is assimilated by plant or animal were during its stay part of the essence of that living being, the numerical identity of embryo and the adult could not be defended. In opposition to such views, the majority of the Schoolmen taught definitely that primordial matter was part of the essence of substance.(2) They urged that the argument from substantial change which proved substantial form to be a part of the essence, also proved primordial matter to be part of the essence. Substantial change consists in the destruction of one specific essence and the production of another specific essence : but that change involves nothing else except the union or separation of primordial matter and substantial form ; therefore, a specific essence is composed of those two principles. They referred their opponents to other texts of Aristotle which suggest that the physical composite consists of primordial matter and substantial form—a doctrine he denies of the accidental composite ; that primordial matter and substantial form are partial natures which coalesce to form the integral nature of the composite—but the nature is, for Aristotle, the essence of the composite ; that the substantial composite is definable by primordial matter and substantial form—but definition is of the essence. They confirmed this philosophy and exegesis by an appeal to theology : certain phrases of the Athanasian Creed that refer to man as composed of body and soul ; a canon of the Council of Trent on transubstantiation that says the whole substances of bread and wine are destroyed. There can be no doubt of the soundness of this view of the majority of the School. But they explained away rather than explained the Aristotelian texts urged against them simply because the School never realised—or at least never confessed—those inconsistencies of the Aristotelian text which are due to the fact that Aristotle never got wholly free from the Theory of the Ideas. They explain away the text referring to definition either, by saying that Aristotle mentions one constituent without denying the other or, by saying that Aristotle refers therein not to the substantial form but to the " metaphysical form," by which is meant the essence as an abstract whole considered in relation to supposit in general. Similar tactics are employed in shelving the text which distinguished composites solely by their form : Aristotle is said to have mentioned merely the more important constituent. The truth is that the School were uncon-

sciously evolving from the Aristotelian text the full consequences of the revolt of Aristotle against Plato: a task which was much easier for writers living centuries later than for one who had sat so long at the feet of Plato. There is no need to deny the Platonic significance of the texts quoted by Averroes, but there is no need to accept them as decisive of the logic of hylemorphism. As for the plea urged by the Master of the Sentences, it was reputed of little worth: some believed that a portion of the body remained unchanged during life and regarded this as an ever-existing stock on which the changing portions could be grafted; others insisted on the continuity of the processes of growth and decay, and on the fact that the living being of each day is the progeny of that of each yesterday; all of them urge that the soul, being the principal part of any living body, suffices throughout all sorts of changes to guarantee numerical identity during life; and most of them add the typical medieval illustration of the persistent identity of a river which, though its waters are ever rushing away, abides ever the same!

The Problem of Union.

The nature of the union between the two constituent principles of substance gave rise to various opinions. Some of these opinions met with little support: the opinion, that this union consisted formally in the intimate presence and mutual penetration, was rejected on the grounds that these were realisable apart from actual union; another opinion, that this union consisted formally in the divine decree willing it, was rejected on the grounds that this decree is extrinsic. The real controversy centred on the question whether union was formally some kind of reality superadded to the constituents: something which acted as a link between them. Scotus, Suarez, their followers, and some of the Thomists pleaded that union was a superadded reality of this kind: the Suarezians and these Thomists interpreting this reality as a substantial mode, the Scotists interpreting it as an extrinsic supervenient relation.(3) Further controversies arose concerning the number and the location of these superadded realities. Suarez, the Complutenses, Rubius, and Aversa admitted only one such union: Suarez planted it in the substantial form alone; the Complutenses in both primordial matter and the substantial form; Rubius and Aversa in the primordial matter alone. Scotists postulated at least two partial unions: one in the primordial matter, and the other in the substantial form. In opposition to all such views, St. Thomas (4) and most of the Thomists stoutly denied the need in union of a third reality distinct from the constituents of substance: granted the requisite dispositions and the mediating action of an external agent, primordial matter and substantial form are immediately united to each other in formal union without the assistance of any superadded reality or mode. "Some (5) ancient philosophers made the mistake of

asking what unites potency and actuality, evidently imagining that these require to be linked together by some intermediary as do totally different bodies. . . . But there is no necessity that these should be united by a bond of the kind that is necessary for totally different beings: hence no cause unifies those things that are composed of matter and form except the cause which produces the change from potency to actuality." "The form of itself makes the matter actual being for it is essentially an actuality: and it does not confer being by the help of any intermediary. Hence, the unity of a thing that is composed of matter and form is due to the form which through itself is united to matter as its actuality. And no other unifying reality exists except the agent which causes matter to become actual being." "Be it known that in the union of the human with the divine nature there is no intermediary that causes union. . . . : just as there is no intermediary reality between matter and form that would be in matter prior to form, for, if there were, accidental being would precede substantial being and this is impossible." "In truth, the very purpose of form is to be, of itself and without intermediary, the actuality of the body: therefore, no third thing makes matter and form one except the agent that reduces potency to actuality." The basis of this Thomistic view is, then, that primordial matter and substantial form are so made for union with each other that they need no third link to accomplish this union. These Thomists insist, reasonably enough, that whatever be the kind of link or the number of links postulated, their opponents are driven at the finish to admit immediate union either between this link and one or both constituent principles or between each of two such links and their respective constituent principles together with a final linkage between the constituent principles thus affected: in other words, the rejection of St. Thomas's solution compels you at the start to multiply entities which can be united at the finish only by the acceptance of his solution.

The Problem of Totality.

Scotus set up a distinction between the composite essence and its constituent principles considered collectively and unitedly: his teaching was that, besides the united primordial matter and substantial form, there was a distinct entity which conferred wholeness of essence. And this Scotist contention was supported by Hervæus, Capreolus, Cajetan, Ferrarensis and Javellus.(6) Two main arguments were put forward: nothing can be the cause of itself and therefore the union of matter and form cannot be the cause of totality of essence; predicates like integrality, generation, corruption can be truly used of the composite essence but not of its unified parts. This theory (7) was rejected by most of the Schoolmen: Thomists, Nominalists, Suarezians. Aristotle expressly identifies the united constituents with the physical whole: the whole is

not anything distinct from its parts; just as pupil and sight are the eye, so soul and body are the animal; the inclusive whole is its contents and these are one essence. St. Thomas is equally explicit: "Humanity must not be thought of as a kind of form resulting from the union of matter and form in the sense of something really distinct from these . . . the reason is that matter becomes actualised through its form and therefore this alleged form would be accidental, not substantial." "The more correct opinion seems to be that the form of the whole is not the form merely of a part and that there is no other form distinct from the form of the part, but that there is a whole which results from the union of matter and form and includes within itself both of these." "Man is neither the body alone nor the soul alone but both together." "Humanity implies nothing beyond the essential principles of the (human) species." The basis of this Aristotelico-Thomistic teaching is that substantial change reveals nothing in the composite essence but primordial matter and substantial form and these two united. There is no proof, then, of this alleged entity of totality. Nor are the Scotist arguments convincing: primordial matter and substantial form are not in their collective union the causes of the composite whole but are identical with it; no predicates are applicable to the composite essence which are not equally applicable to its constituents when taken collectively and unitedly. The growing consensus of opinion against the Scotist view became gradually overwhelming; and after the beginning of the sixteenth century, it was scarcely heard of in the School.

Essence and Existence.

The Schoolmen were unanimous in holding that the essence of a creature, considered ideally and in the abstract, was really distinct from its existence. But a doughty controversy arose as to how in any existing creature, its essence was distinguished from its existence. St. Thomas (8) and almost all the Thomists maintained that the essence of any existing finite being was really distinct from its existence. Alexander (9) of Hales, Aureolus, Henry of Ghent, Durandus, Gabriel Biel, Hervæus, Suarez and Vasquez held merely a mental distinction founded on reality. Scotus and the Scotists (10) held a distinction of a diminutive but of a real order—*distinctio formalis a parte rei:* a distinction that is real, because antecedent to our thinking, and that is formal, because not between thing and thing but between distinct formalities.

The basis of the Thomistic view is that the identity of essence and existence involves self-existence. St. Thomas argues that essence must be really distinct in finite beings from existence because creation and production imply the reception of existence from a source other than the essence itself. He compares essence and existence in creatures to potency and actuality: but there is,

necessarily, a real distinction between any potency and its actuality. Elsewhere, he argues that identity of essence and existence involves infinity because there is nothing within or without such an essence to limit it: but two infinitely perfect beings are impossible; consequently this identity of essence and existence can be realised only in God. "It must,[11] therefore, be held that essence and existence differ conceptually in simple beings but really in composite beings. . . . But there is only one simple perfect being—God." "Every being that belongs to the genus of substance is composite in the sense of admitting real composition: the reason is that everything which belongs to the category of substance is self-subsisting in its existence; consequently its existence must be different from itself, otherwise it could not differ in existence from those others with which it agrees in essence." This real distinction of the Thomists is obviously not of the kind that prevails between individuals each of which has its own existence. Neither is it a distinction between thing and thing when you take thing—as medievalists were apt—to mean a complete essence: "the actual reality of existence is not, strictly speaking, a thing because it is not any kind of essence." [12] But while denying that existence was a complete essence, Thomists asserted that it was something really superadded to the essence. Hence their plea is for a distinction between two realities, each of which has a distinct value and a distinct definition: essence is the thing, existence a something added to this thing which makes it actual and present. This superadded reality of existence cannot be an accident because existence accrues to a complete essence, not to a complete being: as long as the essence lacks existence, there is no actual substance; and accidents supervene only when the actual substance is formed. Hence existence belongs—*reductive*—to the category of substance. That is why Thomists occasionally speak of existence as one of the factors of substance: primordial matter is actualised by substantial form and thereby made fit for the reception of a single existence. "It is wrong [13] to hold that matter and body or matter and form have distinct existences . . . for the same existence belongs to the composite and its parts." "Just as a luminous body has only a single light-giving quality, so there is only one existence in a whole composite, for instance, in a tree." Primordial matter, substantial form and existence complete one another: each of the latter two develops a potency of its predecessor; and prior to that total development, there is no existing being. There is for the Thomists, then, only one actuality of existence, and that belongs neither to matter nor to form but to the composite which results from their union.

The basis of the opposing view is that existence implies merely the placing of an essence outside its causes: actualised essence is nothing more than possible essence realised outside its causes. But an essence remains the same essence whether thought of as possible or as actualised. Moreover, a being in

potency and the same being in actuality cannot result in real composition : one of these two states excludes the other. Therefore, there can be no real distinction of essence and existence in any finite existent. Another line of argument is based on the fact that if existence was really distinct from essence, they could be separated by God : but this is impossible for their separation would result in an essence that exists without existence and an existence that is the existence of nothing. Thomists retort that these and similar arguments are the logical consequence of a defective starting-point. It is true that whatever exists is outside its causes. But the pertinent question is: how is this existence outside the cause effected and maintained ? what keeps the actualised essence from relapsing into nothingness ? You do not tell what gravitation is by saying that it keeps the earth whirling round the sun : you indicate, thereby, not its intrinsic nature but one of its effects. For a similar reason, the definition of existence as that which puts an essence outside its causes is incomplete. Existence requires for its maintenance as much energy as does action : just as action is the actuality of active power so existence is the actuality of essence. Now the active force is distinct from the effect which it produces. And in a similar way, existence is really distinct from the essence which it actualises : the actualised essence is simply the essence placed outside its causes, but that which places it and keeps it outside its causes is an actuality really distinct from itself ; in short, existence is an energy of some kind whose presence keeps the essence out of nothingness. This controversy was tossed up and down as an apple of discord all through the medieval period. It affected various turns of argument for and against other scholastic theories. Whatever view one takes of the controversy as a separate problem, it is well, in view of the large claims occasionally made on behalf of the Thomistic solution, to recall the warning of Soto.(14) " There is nothing certain in Aristotle about this first distinction (that of essence and existence in concrete finite beings) : but St. Thomas (*De Ente et Essentia*, c. 5, 11 *contra Gent.* c. 52, and 1 p. q. 3, a. 4, and frequently elsewhere) sets up as the essential difference between God and creatures the fact that in God alone being and existence are of the quiddity and essence : on the grounds that God is the primary cause and that if existence were not due to Himself, He could not have got it from any other source. In creatures, on the other hand, existence is not of the essence because their essences are eternal but receive existence from God at a definite moment as already proved. . . . This is not the context for further discussion of these points. I wish to add, however, that, provided a thinker does not deny the difference between God and us which consists in the fact that existence is of the essence of God but not of the essence of creatures, it is of comparatively little importance whether he admits or denies this (real) distinction (between essence and existence in existing creatures) : just as the thinker

who denies that sitting is distinct from the sitter does not deny anything important provided he does not insinuate that sitting is of the essence of man ; in fact, some term this latter distinction real, and perhaps rightly."

The Schoolmen were unanimous on this point emphasised by Soto : namely that existence in creatures was a gift from God. This was clear with regard to those beings that were created at the beginning. God alone is creative. Of course, this gift of existence was not interpreted as a reality passing from the Creator to the created : a portion of divine substance which is given to His handiwork. Existence in God is necessarily infinite, indivisible, incommunicable : existence in creatures is a something that is given, limited, individual. All that can be said is that created existence is due to the omnipotence of God, and, that the particular gift which it is, consists in an action freely originated by God and accomplished in His creature. But the Schoolmen were not agreed as to the manner in which this gift was transmitted in regard to realities which were produced.[15] Some of them interpreted various texts of St. Thomas as implying that secondary causes could produce only the essence of such realities and that God produced their existence. Others took St. Thomas to mean that God, as principal cause, produced existence but employed the secondary cause as instrument in that production : the distinctive mark of this theory is that God, in producing existence, uses the secondary cause merely as a channel through which His power passes somewhat as a Raphael uses his brush to convey his skill to the canvas. The third, and more general, theory was that God communicates to secondary causes not merely the power of producing the essence of a substance or of an accident, but also the power of producing the existences of these essences : the distinctive mark of this view is that creatures in their own order, and with due subordination to the First Cause, produce existence. St. Thomas, Cajetan, Ferrarensis, Scotus and Suarez support this third view.[16] They argue that secondary causes cannot be said to be truly efficient unless they produce existence as well as essence: for, until essence and existence are united, there can be no actual effect. And they urge that no valid reason can be assigned for excluding existence from the scope of secondary causality : a secondary cause can produce an essence because it is itself an essence ; a secondary cause can produce existence because it is itself existent ; and it produces both with the concurrence of the Infinite.

The Principle of Individuation in Material Substances.

The problem of the individuation of bodily substances arose out of the attempt to explain why one individual of a species differs merely numerically from other individuals of the same species. It was admitted by all the Schoolmen that the signs

by which individuality is recognised are extension and the qualities connected with it. But it was also universally allowed that these accidents could not constitute the intrinsic reason of the individuality of each substance: the accident presupposes the substance. "It is said that definite dimensions in matter are the cause of individuation. This does not mean that quantitative dimensions cause individuality for an accident cannot cause its own subject. What it does mean is that the individual is discernible here and now by these definite dimensions: they are signs peculiar to and inseparable from individuality." (17) The accidents, then, cannot be the principle of individuation in substance. But in the course of the controversy nearly every other factor was suggested by someone or other as this principle of individuation: primordial matter or substantial form or existence.

By degrees, however, medieval opinion rallied to one or other of the three leaders: St. Thomas, Scotus, Suarez. Scotus (18) taught that the individuation of substances was effected by some positive reality which is formally distinct from and extraneous to the specific nature: a reality that was styled "thisness." Thisness is certainly neither primordial matter nor substantial form, nor the composite, nor quantity. But it is difficult to know what it is: if thisness means that the specific nature is made formally individual by some kind of individual differentiation, then Scotus does but affirm the fact whence the whole controversy springs—the multiplication of individuals within a species; if thisness means the substantial entity of each substance, then Scotus coincides with Suarez; if thisness means some kind of accidental reality, then Scotus advocates an insufficient reason for the individuation of substance and assumes, moreover, an accidental entity for whose existence no decisive proofs are proferred. Suarez (19) and the majority of his School taught that each substance is individualised by its actual entity, in short, by the fact of its existence: once a substance exists, be it simple or composite, it is a reality undivided in itself and divided off from everything else, in other words, an individual. Suarez does not deny that the common nature of each individual is logically distinct from its individual entity; nor does he deny that individuality adds to the specific essence some distinctive seal which, from a metaphysical point of view, functions as an individualising difference; but he does deny that this individualising difference has any basis, in the existent, distinct from the entity of the substance: hence, his view that each substantial existent is of itself and through itself the principle of its own individuation. This thesis of Suarez can hardly be contested. Each existing being is an individual: that incommunicability and that distinctiveness from others which results from individuality belongs only to substances that exist; all existing substances have a distinct and an undivided existence. There is no dispute about the fact that an undivided existence makes a unit of every existing individual. But since the existing individuals

of each species are repetitions of the formal type, the question remains as to what it is that distinguishes them as numerical patterns of this species. Thomists contend, then, that the Suarezian theory is incomplete: the problem remains why the existence of a particular individual is its own and not that of another individual of the same species; if several individuals belong to the same species, why is not their existence the same? Their own view is that the principle of substantial individuation is to be found in primordial matter as affected by quantity: substantial form cannot be the principle of individuation because it is, of its nature, communicable to many; primordial matter cannot be this principle because it is, of its nature, neither incommunicable nor distinct. This Thomist theory is the express teaching of St. Thomas [20]: his principle of substantial individuation is *materia quantitate signata*. But, as he was not explicit on what he meant by this formula, various interpretations arose in the Dominican School.

One group of Thomists [21] interpret this formula as implying the actual information of primordial matter by the accident of quantity: individuality, those argue, implies incommunicability and distinctiveness, and the incommunicability is given by primordial matter, the distinctiveness by quantity. Many of their brethren object to this interpretation: quantity informs the composite, not primordial matter; moreover, quantity as actual formal principle bestows merely accidental perfection. Hence other Thomists [22] suggest that this individual determination of primordial matter is effected by a mode of some kind which is distinct from quantity: in their view, primordial matter is determined by some real mode—perhaps accidental, perhaps substantial—that is naturally distinct from it, and that precedes the introduction of substantial form with its quantity and other accessory properties. Their brethren object that the assumption of such a mode is gratuitous, and that the question arises whether this mode or the primordial matter is the principle of individuation: if the matter, then the mode is useless; if the mode, then St. Thomas's formula is abandoned. There remain two further interpretations of the formula: both defended by Cajetan and both popular with Thomists.[23] Cajetan's first interpretation was that the sealing of primordial matter by quantity, which St. Thomas taught to be the principle of individuation, consists in the fact that primordial matter is intrinsically fashioned beforehand for the reception of this quantity to the exclusion of that: this predisposition of primordial matter towards a particular quantity is effected by the agent that disposes it for a particular form because the form in question postulates this, and not that, quantity. Primordial matter is intrinsically individuated by its connotation of a particular quantity: it, in turn, individuates the substantial form; the substantial form, in its turn, individuates the whole entity of the substance; and from this whole entity, thus individuated, arises thisness or the individ-

uating difference within each species. On this view, individuated primordial matter is not a principle of individuation in the sense that it is itself the individualising difference, but in the sense that it is the fundamental cause of thisness or the resulting individuation of the substance. The argument for this theory is its sufficiency: primordial matter is an intrinsic substantial principle, and its determination is not an accident but a relationship with a particular quantity: this determination is the source of incommunicability because matter, thus determined, is capable of this quantity and not of any other; this determination is the source of distinction because quantity involves juxtaposition of parts and, consequently, distinct locations in space. When their opponents object that primordial matter looks first to the substantial form as subject and only subsequently to accidental forms like quantity, Thomists refer them to the medieval formula—*causæ ad invicem sunt causæ:* causes, according to their respective causalities, may bear different relationships to one another. It is true that, from the point of view of receptive causality, primordial matter looks first to the substantial form and only subsequently to the accidental form. But the point of view of dispositive causality involves a different relationship: primordial matter is prepared for one substantial form rather than another by previous dispositions and, among these, quantity is of the first importance; consequently, primordial matter from this point of view looks first to the accidental dispositions, including quantity, and subsequently to the substantial form. Quantity is the first of these accidental forms and by its presence portions off primordial matter into parts: this division into parts leads to that separateness of parts which adapts the various parts either for a single substantial form of a particular species or for the several substantial forms of distinct species. For all that, the quantity which individuates the resulting substance is not the perfect accident that afterwards inheres in the subsequent composite. The individuating quantity is an imperfect accident that prescinds from definite dimensiveness: it precedes the composite, and is really merely a relationship of primordial matter towards definite quantitative limits; still, it suffices for individuation because it breaks up primordial matter into portions that are numerically different from one another. So much for this first interpretation of Cajetan which is the ablest attempt of Thomism to grapple with the inner meaning of St. Thomas's formula. Cajetan (24) suggested, at a later date, a subtle modification of this interpretation. By determining matter he wished, on second thoughts, to be understood not matter in potency to quantity but matter numerically distinct: matter, not as the receptive subject of quantity, but matter as the root of quantity by priority of nature; in other words, matter as virtually precontaining quantity. This virtual pre-existence of quantity in primordial matter means that primordial matter is numerically distinct in itself before it is quantified: Cajetan's argument being

that, thus only, would the effect be proportionate to the cause since the numerical distinction of individuals within any species is not quantitative distinction but the basis of quantitative distinction. "Determining [25] quantity and terminated quantity are two different things. Quantity is said to be determining when it marks off *this* as numerically distinct from *that* and yet leaves unsettled the further stage whether the portion thus marked off be terminated and completed by a substantial form or have such and such quantitative dimensions: and that is why it can be a principle of individuation inasmuch as it is precontained in primordial matter. But terminated quantity refers to the same numerical portion when considered subsequent to its termination and information by the substantial form: thus considered, it involves definite dimensions, v.g. two cubits, and is not the principle of individuation." Suarez confesses his inability to grasp the alleged difference between these two interpretations of Cajetan: he argues that primordial matter—for Cajetan—cannot already possess quantity as an efficient cause but must possess quantity solely as a material cause; and he concludes that prior possession as a material cause can mean nothing else than a state of receptive potency; in short, that Cajetan's second interpretation coincides with his first. And the subsequent neglect of Thomists to emphasise the alleged distinction between these two interpretations of Cajetan, suggests that Suarez is right in suggesting that they are identical in meaning.

Essence and Subsistence.

A substance that is complete, both in specific essence and in specific nature, and that exists as a single whole in, by, and for itself, is called by the Schoolmen a supposit. Hence in an inanimate supposit, there are various realities: the individualised existing essence; the properties that flow from and are inseparable from a specific essence; the adventitious accidents that are caused by external influences; and the distinguishing characteristic of subsisting in by and for itself as a physical intrinsic whole, which is not and cannot be part of the being of another but is an independent and incommunicable individual. Now that something which transforms the essence into a supposit by making it intrinsically independent of, and incommunicable to, any other being is called subsistence. Our present question refers to the nature of this something: what is it? and what is its relation to the essence? Henry of Ghent and Durandus held, with Aristotle, that the only difference between essence and subsistence was that between an abstract and a concrete individual. St. Thomas seems, in some of his works, to approach this view: he insists that subsistence is really distinct from essence in material substances; but he does not interpret subsistence as a special reality superadded to the essence; he inclines to account for

subsistence by the individualising properties and accidents. But the great antagonists of subsistence as a positive entity were the Scotists: for Scotus and his disciples, subsistence consists merely in the fact that the essence is not actually dependent on any other being. All these thinkers [26] agree, then, in denying that subsistence is a special kind of positive entity which is distinct from the essence and is added to it for the purpose of making this essence incommunicable. And all of them rely on the following argument. When you distinguish in any existing individual its primordial matter, its substantial form, its properties, its existence, and its individualising circumstances, you appear to have exhausted its stock of positive realities. Now, entities are not to be needlessly multiplied. It is true that the complete substance is incommunicable. But that incommunicability seems to be sufficiently explained by the normal conditions of individual existence. An individual is a whole in itself and has its own independent existence. If, owing to supernatural causes it is subsumed by another, it loses, indeed, its independence of supposit, but there is no need to suppose that it loses any special positive reality. To this teaching, their opponents made the following philosophical objection. A supposit is certainly something positive: it implies integrity and totality in substance. Scotists, in reply, distinguished three kinds of substantial integrity and totality—integrity and totality of essence, of nature, of incommunicability: certainly, the first two kinds refer to positive realities, but the objection does not refer to them; and the third kind of integrity and totality, the self-centred mastery of itself by a substance, is also in a sense something positive but it is attained by the mere fact that a substance is not part of the being of any other substance.

Cajetan made famous in the School the contrary view which interprets subsistence as a special kind of positive entity: he rallied to his side the majority of the Thomists; his general view was endorsed by Suarez and his disciples; and all of these supporters of the positive reality of subsistence claim as their patron, St. Thomas.[27] But these thinkers were not of one mind as to the nature of the positive reality attributed to subsistence. Most of the Thomists thought of subsistence as something intermediary between essence and existence but really distinct from both: subsistence, when received into essence, makes this latter incommunicable; existence, when received into supposit, makes this latter actual. A few Thomists held that supposit adds to the essence only the individualised substantial existence: in other words, these Thomists identified subsistence with the existence of the essence. Suarez and his disciples, denying as they did any real distinction in actual substances between essence and existence, interpreted subsistence as some kind of a substantial mode which completes the essence by rendering its existence incommunicable. The gist of philosophical reasoning in favour of the positive reality of subsistence

ran: that mode of subsisting separately from other beings is something negative, inasmuch as it merely excludes substantive communication with these others: but that mode of subsisting separately from other beings is something positive, inasmuch as it fashions the substance into a completely rounded whole, within which the substance reigns master of itself and independent of all others.

This exposition touches merely the philosophy of the problem. The graver arguments and objections were drawn from the Mystery of the Incarnation: in the God-Man, there are two distinct natures in the unity of Person. For critical appreciation of these issues, the student must look to the science of Theology.

The Distinction between Substance and Material Accidents.

"Substance is being inasmuch as this being exists by itself; accident is that whose being is to exist in something else." "Substance is a reality to the nature of which it is due that it should not exist in another. But accident is a reality to the nature of which it is due that it should exist in another." These definitions of St. Thomas [28] express the general medieval teaching: substance alone fully is: accident has but a diminished being inhering in substance. These definitions embody also the accepted teaching of the School of some kind of distinction between substance and accident: so many changes occur in material bodies without affecting the identity of these bodies that there must be some self-subsisting recipient of these changes; that recipient is substance; its successive and different states are the accidents. There are, however, accidents and accidents; and the distinctive feature of medieval Cosmology in this context is its doctrine of a distinction between substance and certain accidents so real that these accidents could exist, preternaturally, apart from their connatural substance. Quantity and the sensible qualities of matter were held to be absolute accidents of this kind by Thomist, Scotist, and Suarezian.[29] The Nominalists [30] made an exception of quantity: for them, this kind of real distinction exists between the corporeal qualities and the substance, but not between any substance and its quantity and not between any quality and its quantity.

Many philosophical arguments were put forward in favour of the general thesis that quantity and the corporeal qualities were absolute accidents. Thus quantity was said to be really distinct from substance for several reasons: no *a priori* case can be made for their identity because their respective concepts are altogether different; nor can any *a posteriori* case be made because inseparability does not necessarily imply identity; quantity is directly perceived by the senses, substance only indirectly; changes of quantity—within limits—do not involve change of substance.

Other arguments were propounded in favour of a real distinction between substance and the sensible qualities. Suarez starts with an appeal to induction: the four elements exercise accidental efficiency by means of their primary qualities—and a real distinction between these and their respective elements was acknowledged; local motion is caused by means of qualities; the heavenly bodies act through qualities distinct from themselves, v.g. through light; non-living mixtures, such as metals and gems, obviously exercise causality through their accidental powers, for we know that these powers can be intensified or weakened or destroyed. This inductive argument was confirmed by an appeal to metaphysical reasonings: an appeal that aroused a certain amount of dissent. It was urged that since potency and actuality must belong to the same genus, the potency which issues in the actuality of the accident of action must itself be an accident: critics retorted that the presupposition cannot be maintained in view of that fact that substance is itself a receptive potency in reference to these alleged accidental qualities. It was urged, also, that qualities can become more or less intense whereas substance cannot undergo such changes; and that since active powers are really distinct from one another, they must be really distinct from the substance. After a review of these and other philosophical arguments in favour of the thesis that sensible qualities are absolute accidents, Suarez frankly acknowledges their weakness: philosophy can give but probable reasons for a real distinction between the substance and the sensible qualities. "St. Thomas (31) with a fair amount of proof establishes, by induction, that in every created nature the immediate principle of action is distinct from the substance, and is, therefore, an accident. . . . To assign an *a priori* reason for this is difficult, though St. Thomas gives several probable arguments . . . which Scotus and others impugn, while Capreolus and Cajetan offer a vigorous and wide-ranging defence. But I think the efforts of these two latter writers unavailing, nor ought a wise philosopher look for demonstration in a question as recondite as this. For unless it can be shown to be above the degree of perfection possible to a created substance to be the immediate and single principle of an act which is in the order of accidents, we can assign no *a priori* reason why our actually created agencies should always stand in need of an accidental principle for actions of the kind in question. We do not know the special nature of these creatures sufficiently well to be able to deduce therefrom the peculiar causes of this need or defect. Hence in trying to develop an *a priori* proof, we must, as St. Thomas wisely remarks, fall back on the general nature of the created being as such. But if we make that general nature the basis of our argument, we are really urging that God could not create a substance that would be of itself an immediate principle of action. It is difficult, however, either to render plausible or to prove a consequence of that kind: infinite perfection in the order of substance does not seem to be necessary in order that a

creature should act proximately and solely by its own substance, but every perfection that is not infinite seems communicable to creatures. If that be so, how do we know that this mode of acting has not been communicated ? or how can we prove the alleged need (of a distinct accidental principle of action) from the general notion of created being ?" This hesitation of Suarez and others, concerning the value of the arguments from philosophy regarding the nature of this distinction between substance and the material accidents, did not affect their belief in the doctrine itself. The thesis of absolute accidents was as certain for Suarez and Scotus and all theirs, as it was for St. Thomas and his. For all of them, its irrefragable basis was the current teaching about the Eucharistic species : after consecration, the substance of bread and wine disappear but the quantity and the sensible qualities of bread and wine persist.

Scotus [32] and his followers, while assenting to the reality of this distinction between substance and certain accidents, maintained that created substance might, apart from really distinct accidents, exercise various forms of activity. Their view was that substance, and it alone, does produce other substances : that substance can produce, immediately and by true physical action, accidents in itself or in another substance ; finally, that all active accidents can, both by real and by intentional action, produce their like in other substances—and can do this, whether united or not with their substrate. The grounds of this Scotistic teaching were alleged to be drawn from experience and from reasoning. Reasoning proves that accidents cannot produce a substance. Experience proves that substance can produce accidents within itself : boiling water when removed from the fire reproduces within itself the natural accident of cold ; the four elements—and all non-living substances—when first generated reproduce within themselves those respective properties which are, confessedly, distinct accidents ; finally, reasoning confirms these facts, for if one accident can produce another, why cannot a substance which is a more perfect reality produce an accident ? Experience proves that substances can produce, immediately, accidents in other bodies : there is no formal quality of heat in either pepper or wine, and yet both of these substances heat palate and stomach ; reasoning confirms this experience in two ways—if a substance can produce accidents in itself why not in another, and if an accident can produce an accident why can not a substance ? Finally, facts prove that, even when the substance is distant or absent, accidents can produce other accidents both by physical and by intentional action ; and if they can do this, when distant from or separated from these substances, *a fortoiri* they can do as much when working with the same substances. If these arguments prove anything they prove that a non-living substance, of itself and apart from its accidents, can cause all those effects which are normally produced by its accidents. All the Scotists accept this conclusion but most of them

teach, in opposition to Mastrius, that when active accidents are united to their non-living substance, they and not it produce similar accidents in other bodies: their plea being that when two causes coexist, one univocal, the other æquivocal, and both sufficient for the effect, this effect must be attributed to the univocal cause, for it is more determined towards that result; and they add that though every medievalist believes the sun can breed frogs in mud, not one of them dreams of ascribing any particular frog to the action of the sun as soon as he is aware that other frogs were previously in this mud. If this exposition be accurate, the ordinary terse statement that Scotists denied a real distinction between the active qualities and their non-living substances is slightly misleading. Scotus and his disciples held that a non-living substance had an activity of its own which it may, and sometimes did, exercise apart from all accidents: but they held, also, that this non-living substance had active powers which were accidents and were really distinct from itself; and they were of one mind with Thomist and Suarezian regarding the theological inference that justified the nature and the number of these absolute accidents.

Ockham and the Nominalists agreed with the general thesis of the existence of absolute accidents, but denied that quantity was an absolute accident. Material substance has of itself distinct extended parts, and so has each material quality: the same reality that is substance as material subject is quantity as distinction and extension of parts, and the same reality that is material quality as colour, heat, etc., is quantity as distinction and extension of parts; consequently, there are in each existing body as many distinct kinds of quantity as there are distinct kinds of positive entities. Primordial matter has its quantity, substantial form its quantity, and the accidental forms their respective quantities: and as these distinct entities can compenetrate one another, it follows that the various quantities can compenetrate one another; it was held, however, that the consistency and thickness of quantity was greater in primordial matter than in substantial or accidental forms. But while thus emphasising the denial of a real distinction between substance and its quantity or between quality and its quantity, Nominalists are not explicit on what degree of distinction they would admit in such cases: since they speak of Christ's Body existing in the Host apart from its normal quantity, they seemed to have admitted some kind of actual distinction between substance and quantity. Their first argument is built on Ockham's razor: "it is idle to do by many things what may be done by fewer." Material substance has of itself really distinct and really extended parts; it has really distinct parts because just as complete entities are distinct from one another, so are partial entities; it has really extended parts because distinct entities, even though they are partial, naturally postulate distinct spatial locations; therefore, there is no need in material substance, and the same

applies to any material quality, of a really distinct accident of quantity. The second argument of the Nominalists is that if God conserved a substance apart from the alleged really distinct accident of quantity, the substance thus conserved would still be quantified for it would still possess its distinction of entitative parts, the union of these parts, and the locations of these parts. A third plea was that God could conserve the alleged really distinct accident in a substance and yet destroy the quantitative nature of that substance: without destroying any part of the entity of a two cubic feet body, God could reduce it to the size of one cubic foot; without destroying any part of its entity, He could reduce this two cubic feet body even to a point—and clearly in this punctual state, the body would not be quantified.

Suarez retails these arguments for the purpose of refuting them: His attitude is that the anti-Nominalist view is sufficiently probable from the standpoint of philosophy, and can be proved convincingly from the theology of the Eucharist. He begins by attacking that ambiguous assertion, in the Nominalist view, of a difference between the kind of quantity that is in substance and the kind of quantity that is in quality. If there be no difference between the various consistencies of primordial matter and of substantial and accidental forms, then, all these entities are genuinely quantified: but then, the Nominalists have no right to distinguish between these various kinds of quantity; moreover, even this theory will not explain the Mystery, for we know that the quantity of whiteness does not of itself expel another body from the same place, and does not of itself make its internal parts impenetrable in their spatial positions. If the quantities of the various forms, accidental and substantial, are different from the quantity of matter this must mean that the local extension of these forms is really due to the quantity that is in matter. That is an intelligible theory. But it is a theory that postulates several new miracles in the Eucharistic species: first of all, it implies that there is no true quantity in the consecrated elements, and no natural explanation of their twofold impenetrability; next, it implies that there is nothing in the consecrated elements to hold the sensible qualities together either among themselves or in anything else; again, it implies that there is nothing in the consecrated elements to account for their natural intensity and diminution seeing that the sensible qualities, there, do not inhere in a subject; consequently, miracles must be postulated for all these purposes. Suarez continues by an attack on the three arguments of the Nominalists. He makes practically the same reply to the first and second arguments: he grants that distinct entitative parts exist in substance apart from quantity—this is denied by the Thomists—and also that these entitative parts can by divine power be differently localised apart from quantity; he denies, however, that this divine local spatialisation would make the substance quantified, on the ground that even two angels can be locally separated. A sub-

stance is not, he urges, quantified unless it has that within it which excludes other substances from its own location and excludes its various internal parts from the locations of one another: and this is impossible apart from a distinct accident of quantity. The substance, of which Nominalists speak, is not impenetrable either in its parts or as a whole: it is one thing to exist in distinct locations, it is quite another thing to exist in these distinct locations in such a way as to exclude from them other bodies or other parts. He replies to the third argument by denying its fundamental assumption: a substance cannot, he holds, become unquantified as long as it possesses the accident of quantity. It is generally allowed that God could reduce a body of two cubic feet to the size of one cubic foot, or, indeed, to any extended size, however small. "God [33] would effect this reduction, however, not by condensation of parts but by their compenetration. He would not make these parts less quantified, He would not make any two parts into one, He would merely localise these parts in the same space; a very different thing. It is controverted whether it is possible to reduce a quantitative whole to an indivisible space: but on the supposition of the Eucharist . . . I have no doubt about the affirmative answer. I deny, however, that a substance, when thus confined within an indivisible space, becomes unquantified: for the Body of Christ has its quantity in the Sacrament although It exists there in an indivisible point. And my reason is, that quantity is not actual but aptitudinal extension in space: hence, a body even when not actually existing in extended space can retain this."

The Origin of Accidents.

Accidents are of two kinds, proper and common: proper accidents, which are also called properties, are accidents that are extraneous to the specific essence of the substance in which they exist but are, for all that, the inalienable heritage and inseparable concomitant of that essence; common accidents are those fleeting, fortuitous accidents which result in any substance from the interplay of surrounding circumstances and which, accordingly, may come or go without prejudice to the specific essence of that substance. No serious controversy arose concerning the origin of the common accidents: they are incidental changes wrought by some cause; educed as they are by external causes out of the potency of their subject, they depend on that subject in production, existence, conservation. Controversy did arise concerning the origin of proper accidents. All agreed that proper accidents originate from their respective substances by a process called dimanation or emanation or resultance. But they were not agreed on the exact nature of this process. Thomists [34] held that resultance was not of itself real efficient causality: once the substance is produced, its properties flow

from it immediately by natural resultance but not by true causal action. Scotists [35] and Suarezians held that the substance produces within itself efficiently its properties. The opinion [36] of St. Thomas is disputed: the greater number of texts seem to imply that properties need no other cause for their resultance than the agent which produces their connatural substance; other texts seem to imply that properties are produced by a distinct action on the part of their connatural substance. Cajetan [37] suggests that properties owe their origin to the efficiency, but not to the action, of their connatural subject: this distinction, between causes that are efficient with action and causes that are efficient without action, is obviously a solution of the fairy godmother type—a cause that did not act could not be truly efficient.

Thomists argue that the suggested causality of the substance is needless: the same cause that produces the substantial form, and thereby the substance, produces what is necessary for the existence and activity of that substance, namely, its properties: the generator ought to produce an effect totally and absolutely. Hence their explanation of resultance: properties as resultants are not the direct term of causal action but the inevitable sequel of the production of substance. The theory of Scotus and Suarez, that properties owe their existence to the causal action of their connatural substance, leads, according to Thomists, to two inadmissible conclusions: one that finite substance is immediately operative; another that non-living substances are endowed with immanent activity. Scotus and Suarez accept light-heartedly the first of these conclusions: it is part of the general system of Scotus; it is the only solution of the origin of substantial form for Suarez. As regards the second conclusion, Scotists and Suarezians reply that non-living substances act immanently for the one purpose of attaining their connatural state: all non-living substances produce their properties, and the four elements, when obstacles are removed, seek their natural places, but their power of acting immanently stops at that; in short, not all kinds of immanent action are vital. The view of Scotus and Suarez was strongly enforced by two quaint consequences of Aristotelian physics: light and heavy bodies when out of their natural places were thought by all medievalists to be able, when obstacles were removed, to move towards their respective places; boiled water when taken off the fire was thought by all to reproduce of itself and within itself the formal property of water, coldness. Scotists and Suarezians insisted on these alleged facts as incontrovertible proofs of the true causal efficiency of emanation. With Aristotelian physics and metaphysics as presuppositions, the only reply Thomists could make to the first alleged fact was that the generative action of the generating cause remains virtually in the substantial form of each generated substance and affords, therefore, even in the absence or non-existence of that generating cause, a sufficient explanation of the motion of the

elements to their natural places. Some Thomists make the same reply to the second fact. Cajetan argued, however, that the property of cold was never expelled by the heat: it was merely hindered from continuing its action by the heat; and when that heat was removed, the property simply resumes its action; therefore, there is no need for any causal action of the substantial form of water.

The Existence of the Accident.

Three opinions were mooted in the School concerning the manner of existence of accidents. Capreolus (38) and a few Thomists taught that existence fell primarily on the substance and secondarily on its accidents: in other words, that the existence of the accident was identical with the existence of the substance. Scotus (39) and Suarez and their followers taught that the existence of the accident was not only really distinct from the existence of the substance but was wholly identified with the essence of the accident. St. Thomas (40) and the majority of the Thomists taught that the existence of the accident was really distinct from the existence of the substance but that, nevertheless, the existence of the accident was dependent on the existence of the substance: in other words, that existence does not belong primarily to the accident alone, but to the individual made up of substance and accident.

The first opinion maintains that there is but one existence in every individual: the existence of the substance, and it is shared by all the accidents, proper and common. Accidents add new perfections to the substance but they do not bring a new existence. The single existence has not the same connexion with the substance and its accidents: it is logically subsequent to, and completes, the substance; it is logically prior to all the accidents. Finally, this existence is the bond of individual unity that welds the substance and its accidents into a concrete unitary being. The chief arguments for this opinion are based on the unity of the individual, and on the nature of accidents. A unitary being cannot have two or more distinct existences: if the substance has its own existence and each of the accidents its own, these distinct realities remain, say and do what you will, a mere aggregate. Again, an accident that has an existence of its own is practically a substance for it is a self-subsisting reality. The second opinion is prevalent amongst all who hold the two theories of the identity in finite existents of essence and existence, and of real distinction between the substance and accidents. Their favourite arguments are two: essence and existence are not really distinct in any finite reality and, consequently, accidents cannot be really distinct from substance except they have an existence of their own; moreover, the existence of the accidents of bread and wine after the consecration compels us to hold, that these accidents have an existence of their own, apart from the

existence of the substance, and if these particular accidents have an existence of their own, all accidents ought to have it.

St. Thomas and the Thomists reject, as we have seen, the basis of the first argument of Scotus and Suarez. Further, they deny the consequence which their opponents draw from the Eucharist: the miracle of the separate existence of accidents in this Mystery consists in the fact that one of them, quantity, receives an existence for itself as a separate reality instead of receiving existence as part of a compound unit which comprises substance and accidents. These Thomists start with the contention that accidents must have some kind of existence because they are realities. That existence of the accidents cannot be identical, however, with the existence of the substance for many reasons: one is that the substance precedes, by priority of nature, its proper accidents and, by priority of time, its common accidents; another is that many accidents are produced by true causal activity, and causation implies the production of a new existence; a third is that an accident which shared the existence of the substance could not be really distinct from that substance. Neither can that existence of the accident fall on the accidents alone: if it did, the accident would become a self-subsisting reality extraneous to the substance. The result would be that such an accident could not unite with the substance to form a concrete individual. Suarez recognised this difficulty, and tried to meet it by inventing a mode of inhesion. This mode creates more difficulties than it solves: it is neither substance nor accident, yet it is a positive entity; as a positive entity it would seem to postulate another mode for uniting itself to the accident, and so on to infinity; and even were this mode united with the accident, the problem of the inherence of the accident in the substance is left on our hands, for a mode of inhesion, that is immediately received into an accident and is a mode of this accident, cannot be a link between this accident and its substance. But while holding that the essence of the accident is distinct from the essence of the substance, and that the existence of the accident is distinct from the existence of the substance, St. Thomas and his disciples insist that the existence of the accident depends on the existence of the substance. There is a dependence of origin and of maintenance: all accidents originate in substance—by resultance or by eduction; all accidents inhere in, and are sustained by, substance; and this double dependence involves, as a necessary sequel, a dependence in activity. The upshot of this Thomistic theory is that the unity which results from the union of substance and accident is unique in its kind. This unity is different from that which results from the union of primordial matter and substantial form: "hence [41] from accident and subject there arises not an absolute (*per se*) unity but a relative (*per accidens*) kind of unity, and that is why their union does not give rise to an essence as does the union of form with matter; hence, also, the accident has neither the nature

of a complete essence, nor is it part of a complete essence but just as it has, in a way, (*secundum quid*) being so it has, in a way, essence." "Existence [41] of this kind (i.e. the existence of the accident) can be multiplied in a single hypostasis or person, for the existence by which Socrates is white is different from the existence by which Socrates is musical, but that existence which belongs directly to the hypostasis or person cannot be multiplied in any single hypostasis or person because one being can have only one existence." Elsewhere St. Thomas insists that this unity is different from a mere aggregation of distinct supposits: "for the subject [42] and the accident are not united in such a way as to give rise to a third something: hence the subject does not exist as a part within this union, but is a whole which is person, hypostasis and supposit; the accident is so linked up with the personality of the subject that the same person and, similarily, the same hypostasis and the same supposit is human and white."

The Individuation of the Accident.

A diversity of opinion, analogous to that which prevailed on the individuation of substance, manifested itself on the question of the individuation of the accident. St. Thomas [43] and his disciples taught that all accidents except indeterminate quantity were individuated by their subject. "Accidents [44] are individuated by their subject: whiteness is said to be a particular whiteness because it is in a particular subject." "Just as accidents have existence in the subject, so they receive unity and multitude from the subject." "It must be remembered that accidents are not individuated by primordial matter: they are individuated by their proper subject which is actual being just as substantial forms are individuated by primordial matter which is their subject." The grounds of this theory is that accidental forms, like substantial forms, are of themselves universal and communicable, and can be made singular and incommunicable only by being received into some individual substrate: and the proper substrate of the accident is a whole substance. This individuation is due to the subject taken, not generally as a subject, but, as a subject existing here and now under particular conditions: the subject individuates each accident inasmuch as it is the patient to the same agent in the same action and at the same time. An exception was made for that peculiarily Thomistic accident of "indeterminate" quantity because it was said to be of its very nature individualised. In opposition [45] to this theory, Scotus and Suarez and their disciples taught that accidents were individuated by their own entity. Accidents cannot, these declare, be individuated by their subject as an intrinsic principle, for the simple reason that they are distinct from this subject. Nor can the accidents be individuated by their subject as a term which is particularly suitable, because the same subject

can receive in succession several accidents which are merely numerically distinct. Here, as in the problem of substantial individuation, the Thomists partially agree with Suarez: they agree that the accident is individuated by its own entity as proximate and immediate principle; they deny that it is individuated by this entity as fundamental principle; their contention is that you cannot help asking yourself the ultimate explanation of the individualised entity of the accident, its thisness, and that, when you do raise this question, you find no answer save in the individuality of its subject.

The Introduction of Physical Intrinsic Modes.

The word "mode" has many meanings in the Philosophy of the School: it is used in Logic to express certain relations between subject and predicate—necessary, impossible, contingent, possible; it is used as the equivalent of difference—the specific difference that contracts the genus, the individual difference that contracts the species; it is sometimes used as the equivalent of all kinds of accidents but, more particularly, of modal accidents as contrasted with absolute accidents. None of these meanings has any connexion with our present topic: the physical intrinsic mode. This physical intrinsic mode is alleged to be some positive factor which is neither a substance nor an accident and yet may concur in determining the build of either one or the other: it is said to be some kind of diminutive entity which, in certain instances, determines positively the manner in which a substance or an accident exists. Most of the Schoolmen held that substance had an existence of its own, and that accident had an existence of its own: and on that account, they termed the substance and the accident realities. These physical intrinsic modes are confessedly not realities in this sense: they are said, indeed, to exist either in the substance or in the accident but they have no existence of their own in any way; not even preternaturally, can they exist apart from that reality of which they are modes.

The origin of this theory of modes is difficult to discover: Durandus who flourished in the beginning of the fourteenth century is said to have invented it; Suarez who flourished towards the close of the sixteenth century is credited with the fame of having made it thoroughly consistent. He certainly was successful in popularising it: after his day, Scotists [46] and Suarezians rallied in overwhelming numbers to the defence of these physical intrinsic modes. Late medieval Thomists were less enthusiastic about this discovery. Hueber, writing at the beginning of the eighteenth century, declares that the majority of the Thomists reject the theory of the modes: he admits, however, that very many contemporary Thomists and a few of the older Thomists defend it. "Durandus," testifies Cardinal Pallavicinus,[47] "was the first to introduce this kind of entity called, by recent writers, a

mode: during the three centuries subsequent to his time, this theory found only an occasional supporter; but since Suarez and other recent writers adopted it and confirmed it by ingenious arguments, this upstart has become dominant in the Schools." Vasquez (48) affirms that the mode of union was invented only a few years previously to the time he himself was writing. And although Vasquez defended the existence of modes, the multiplication and invention of needless ones forced him to utter a warning. "To multiply modes (in the way in which some authors did, by postulating a mode of union for two partial subsistences in the one supposit) and to explain everything in Philosophy by modes and modes of modes is ludicrous: especially as things can be philosophically explained quite well enough without them." But once this new theory became fashionable, Mastrius discovered it everywhere in Scotus. So far as my reading permits me to hazard an opinion, no advocate of the theory has been able to find a genuine trace of it in the text either of St. Thomas, or of the great Dominican commentators on St. Thomas.

Suarez defines a physical intrinsic mode as something positive which affects the reality either of a substance or an accident, and bestows on that reality something distinct from either essence when actually existing: this something ultimately determines the state of that existence, and yet does not add any new entity but merely modifies the pre-existing entity. Some of the modes are substantial: the mode of union between primordial matter and substantial form. Others are accidental: for instance, the mode of inherence that affects an accident. Anti-modists (49) in the School urge that this definition involves a contradiction: if a mode is something positive and distinct from the reality which it effects, it is impossible to maintain that the mode does not add an entity of its own to that reality. The only reply that can be, or has been made, to this objection is that Suarez's denial of the entity of the mode must not be interpreted too strictly. But, Suarez dare not consent to this suggested emendation of his theory: when you ask why primordial matter and substantial form cannot unite of themselves and, yet, can unite by means of the mode of union, the strong point of his defence is that this mode is not strictly an entity: when you ask why accident and substance cannot unite of themselves and, yet, can unite by means of the mode of inherence, again the strong point of his defence is that this mode is not strictly an entity; did he concede that either of these modes was strictly an entity, he would be launched on the infinite regress in both instances. Nor are, anti-modists urge, the arguments for these modes compelling: Suarez suggests that primordial matter and substantial form are indifferent to union or to separation and, therefore, need a mode of union to overcome this indifference; and he makes a similar plea for the mode of inherence. But it was the older teaching that whatever indifference may exist either between primordial matter and substantial form, or between substance

and accident, is overcome by the extrinsic agent that brings into existence these realities; and that, as a matter of fact, there can be no intrinsic indifference since these respective realities are made for union with each other. And when the modists invented these linkages, those who were faithful to the older Masters urged that if these two modes brought about immediate union, why could not union be brought about without either of them; and that if these two modes brought about union only mediately—that is, by the help of other modes—modists are committed to an infinite and useless multiplicity of modes.

The general argument in favour of accidental modes may be summed up as follows: real changes of an accidental nature occur in bodies which are not adequately explained by the accidents: since these changes are real, they can be explained only by the presence or absence of something positive; therefore, physical intrinsic modes, which are not accidents, must be admitted. The examples put forward of these real changes are all of the same type: a man must have some position, but that position is always determinate—standing, sitting, reclining; a body must have some shape, but that shape is always determinate—square, round, oblong; an individual must exist somewhere in space, but that somewhere is always determinate—Rome, Paris, Oxford; an individual must exist somewhen in time, but that somewhen is always determinate—Monday, Tuesday, Wednesday; and so on *ad nauseam*. The changes involved in the presence or absence of these determinations are not mere nothings; neither are they illusions of our senses or of our intellect; therefore, there must exist, for each of them in their respective order, this ultimate determining diminutive entity, the physical intrinsic mode. Lessius condenses the gist of this style of reasoning in a single argument. "Who will say," he writes,(50) "that shape is merely logically distinct from the thing which it shapes, or that when a body that was a sphere becomes a cube, it is changed not really but conceptually or for our minds? . . . Hence there must exist modes really distinct from things and adding something to these things: otherwise, the modes in question would not be genuine, would not truly determine, would not cause real change." The strength of this reasoning lies in the suggestion that if shape be not a diminutive entity really distinct from body, there would be not a real but a conceptual change when any particular shape is altered: That suggestion is, to say the least, doubtful: even if a shape be not a physical intrinsic mode distinct from the body, the juxtaposition of the various parts of the body is real, and it is this juxtaposition that gives rise to the shape. Again, what can be meant by the shape of rotundity, in the sense of a physical intrinsic mode distinct from the body which is thus modified? Modists declare this mode and the body to be two distinct positive somethings. On this supposition, the question arises whether or not the body that is affected by

this mode of rotundity has its parts so juxtaposed as to give rise to a round shape: if it has, then, the body itself is round apart from the mode; if it has not, if it has parts so juxtaposed as to give to a square shape, then, how can the mode of roundness make this square body round? The truth seems to be that the results attributed, in each instance, to these alleged accidental modes are due either to the internal relations of the various parts of a bodily substance, or to the external relations of that body with its surroundings. These various relations do not add to the body any distinct reality of that kind which is meant by a physical intrinsic mode: they are due to the action of some extrinsic cause or term; and they cease to exist when that action fails.

This sketch must suffice as an account of the beginnings of a theory which has been a fruitful source of controversy within and without the School. Within the School, various con-promises not always defensible in detail have long since put an end to the acute phases of this controversy. But the older Thomists would make no compromise. "It cannot (51) be proved," writes a Thomist at the beginning of the eighteenth century, "that either Aristotle or any of the older philosophers made any mention of this new kind of mode: it is manifest that they accounted for all these indifferences of things without it; now if these indifferences were explained sufficiently without modes in older times, they could also be explained sufficiently in our day without modes." "I deny, then," writes another Thomist (52) of the same period, "that anyone before Durandus ever spoke of these modes. I grant that the authority of recent writers is weighty and deserves serious consideration. But as in other and even greater controversies, the upholders of the opinion that these modes ought not to be defended in the Schools can quote on its behalf the more important names." "Recent writers," declares a Thomist (53) about 1753, "have made of all things, that are neither complete substance nor quantity nor quality, modes, and have invented a vast number of other modes. Nor were they content thus to pile up mode on mode: they insisted, also, that these modes are actually distinct from the things to which they are attached. They seemed to themselves to explain away every difficulty that arises about the determination of things, and to fill up every void in nature by this class of meticulous entities. The Scotists went further: for they invented, in addition to physical modes, an almost countless host of metaphysical modes. . . . But despite the labour that all these authors have expended on modes, not one of them has up to the present given a blameless description of a mode, not to speak at all of a definition. . . . And although there has been this vast conspiracy of authors in recent centuries on behalf of these modes, it is not true that the Thomist or Scotist School or even the majority of the Jesuits support these modes because the ancients never admitted modes of the kind defended in recent

times. And it is worth remembering that no text of St. Thomas can be quoted in favour of these modern modes : not even one text of his can be safely appealed to by the Modists, despite the general use of the word itself. Our Salisburg professors have, as a body, rejected these modes : our Congregationists have, also, in great numbers rejected them ; for the excellent reason that, by doing so, they relieve Philosophy of a heavy burden, and can devote their time to the study of things and of their natural activities, rather than to the study of meticulous modes or relationships that have nothing to do with nature."

CHAPTER VII.

THE ARISTOTELIAN SCHOOLMEN ON QUANTITY.

A QUANTIFIED reality, writes Aristotle, is one that is divisible into parts which are in it and which are capable, after this division, of existing as individuals. St. Thomas when commenting on this definition points out that it, while assigning divisibility as the chief note of quantity, excludes certain kinds of divisibility from quantity. Quantified reality must contain formally the parts into which it may be divided: hence, the dissolution of a true mixture into the four elements is not a proof of the quantification of that mixture. Quantified reality must be capable of division into parts which, after division, can exist as individual beings: hence, the divisibility of an essence into substantial form and primordial matter is not indicative of quantity. Thanks to this twofold condition concerning divisibility, Aristotle's definition is applicable to quantitative wholes and to them alone. But there is quantity and quantity. Quantity is discrete, when it is made up of parts that are really distinct from one another and have, each of them, a limit of its own; its unity is merely mental, and since its parts are really distinct from one another, it is a multitude or a number of realities. Quantity is continuous when it is made up of parts that are not really distinct from one another and that are so united with one another that the limit of one is identical with that of the next: its unity is independent of the mind; and it makes up a magnitude that is either wholly or partially measurable according as it is finite or infinite. Now, there are several kinds of continuous quantity: in particular, successive and permanent quantity. Successive quantity has integral parts that uninterruptedly follow one another according to an order of before and after; its principal subdivisions are time and motion. Permanent quantity has all its parts existing simultaneously, and these parts occupy different positions in space: it is generally called extension. Extension is mentally divisible into several kinds: extension of three dimensions representing a body as it really exists, and known as volume; extension of two dimensions representing a body under the double aspect of length and breadth, and known as surface; extension of one dimension representing a body under the one aspect of length, and known as line.

Throughout this chapter, the only quantity that is in question is permanent quantity.

Medieval Presuppositions.

The Schoolmen developed their theory of permanent quantity under the guidance of Aristotelian Physics and of theological corollaries drawn from the Theology of the Eucharist. From Aristotle,(1) the Schoolmen learned that the formal extension of non-living bodies is an undeniable fact of sense perception; that the quantified body is mechanically divisible into parts each of which is capable of existing as an individual; that it is extended, having parts outside parts, each in its own spatial position; that it is measurable and can serve as a standard of measurement for other bodies; that it is impenetrable in two ways, firstly its internal parts are mutually impenetrable, secondly the whole body as a single substance is impenetrable to other material substances; that it is as a whole a continuum, namely, a single substance whose parts have not of and for themselves subsistence; that it has the three dimensions—length and breadth and thickness. This Aristotelian view of quantity was, however, affected by consequences which were believed by medievalists to be implied in the theology of the Eucharist (2). This medieval modification of Aristotle's theory of quantity was based mainly on two corollaries: the separate existence after consecration of the accidents of bread and wine; the quantified existence of Christ's Body in the consecrated species. A word about the history of these corollaries is advisable.

Faith teaches that the substance both of bread and of wine is changed into the Body and Blood of Christ. Our senses perceive no change in the sensible appearances of either bread or wine after the words of consecration. Now, whatever may have been the connotation of the term "species" in the primitive doctrine of the Eucharist, St. Ambrose explicitly interpreted this term as referring to the accidents of bread and wine: *nil falsi putandum est in sacrificio veritatis*. Thus, centuries before the Latins came into contact with the metaphysical treatises of Aristotle, Catholic theologians had accepted the view that the accidents of bread and wine remain after the consecration. This doctrine of separable accidents, though acknowledged by all the School, was explained in different ways: quantity and the sensible qualities were separable for Thomist and Scotist; the sensible qualities and their respective quantities, as distinct from the quantity of the substance, were separable for the Nominalist.(3)

The second important point in the medieval theory of quantity arose out of the question whether quantity and the accidents, naturally connected therewith, were present with Christ's Body in the Eucharist.(4) Most of the Schoolmen answered this question in the affirmative. Durandus, Major, Gabriel, Ockham and their followers dissented: but, with differences of implication. Durandus admitted a real distinction between substance and quantity but, as he believed the essence of quantity to consist in local extension and impenetrability, he naturally concluded that

Christ's Body was not quantified in the Eucharist ; then, he drew, logically enough, a similar inference with reference to accidents like heat and colour which inhere immediately in quantity. Ockham and the Nominalists denied a real distinction between a substance and its quantity but, since they admitted a real distinction between a substance and its sensible qualities, they were driven by their interpretation of "species" as the accidents of bread and wine to admit in bodies another kind of quantity, distinct from the quantity of the substance, and, peculiar to the sensible qualities. The quantity of substance consists for Nominalists in local extension which gives sensible mass and natural impenetrability : hence, that kind of quantity was not present with Christ's Body in the Eucharist ; Christ's Body was in their view not actually but potentially quantified in the Eucharist. They also excluded from Christ's Eucharistic Body those other kinds of quantity that are proper to the sensible qualities ; the sensible qualities of Christ's Body are, in the Eucharist, without their respective quantities and inhere immediately in His Body. This view of Durandus and the Nominalists was rejected by the rest of the School. All the others sided with St. Thomas : "Since the substance of Christ's Body is not really deprived of its dimensive quantity and its other accidents, it follows that, by reason of real concomitance, the whole dimensive quantity of Christ's Body and all its other accidents are in this sacrament." (5) Suarez tells us that some believed the opinion of Durandus to be heretical. He hesitates on several grounds about attaching so grave a note of censure ; he has met no express conciliar definition, and he can discover no absolutely convincing argument based on revealed principles against it. His view is that the strong arguments against Durandus are drawn from philosophy : that these arguments are sufficient, almost certain, yet not absolutely evident. He feels inclined, then, to agree with Alexander of Hales in declaring the theory of Durandus erroneous : he is sure that it is, at least, temerarious : it opposes the teaching of the great theologians : it needlessly introduces many unbecoming and absurd consequences into this Sacrament ; it is hardly consistent on this topic with the language of Scripture, of the Councils, and of the Fathers, for, all these imply in their utterances that Christ's Body exists in the Eucharist as it was on earth the night of the last Supper and as it is in heaven since the Ascension. Then if you go further and ask, says Suarez, whether the presence of other accidents is also theologically certain : I am inclined to answer . . . not with regard to all of them and not with equal certainty. For instance, local presence and those accidents which depend intrinsically on it such as motion, nearness, distance, are absent : Christ's Body has not in the Eucharist that local presence etc. which It has in heaven. But with regard to those accidents which do not depend on local presence and yet are purely contingent, for example, the sensible species of corporeal vision in heaven or the various

degrees of temperature on earth, opinion is divided. Major denies the presence of these in the Eucharist, because they depend on extrinsic causes which may operate at one spot or one time and not at another—and this denial is not as improbable as the already rejected theories of Durandus and the Nominalists for two reasons; firstly, because it does not detract from the connatural disposition and perfection of Christ's Body; secondly, because it is not contrary to the ordinary language of Scripture or of the Saints. St. Thomas holds a contrary view, however, and his teaching is more probable in itself and more widely accepted, because the general argument from real concomitance implies the presence of these accidents and, because there is no compelling reason for their exclusion. Medieval writers, therefore, taught as a theological certainty the presence of the quantity of Christ's Body in the Eucharist. "That which belongs to Christ is in this sacrament in a twofold way: one way by reason of the sacrament, another way by reason of real concomitance. The dimensive quantity of Christ's Body is not in this sacrament by reason of the sacrament itself: for only that which is the direct term of the change (of substance) exists in this sacrament by reason of the sacrament. But the direct term of the change that occurs in this sacrament is the substance of the Body of Christ and not Its dimensions: this is clear from the fact that, after consecration, only the substance of bread passes away while the dimensive quantity of bread persists. But since that substance of the Body of Christ is not really divided from Its dimensive quantity and from Its other accidents, it follows that, by reason of real concomitance, the whole dimensive quantity and all the accidents of the Body of Christ remain." "Since, therefore, the substance of the Body of Christ is on the altar by reason of this sacrament, whereas Its dimensive quantity is there concomitantly and in a sense incidentally, it follows that the dimensive quantity of the Body of Christ exists in this sacrament, not in its natural manner . . . that is, not whole in the whole and each part in each part . . . but after the manner of a substance whose nature is to exist whole in the whole and whole in each part." (6) In other words, the quantity of Christ's Body was present in the Eucharist apart from all those external manifestations which had seemed to Aristotle to be necessary: local extension, divisibility, impenetrability, measurability.

The Essence of Quantity.

By the essence of quantity the School understood that effect which the presence of this accident confers first of all and with absolute necessity on its subject. This essence was, accordingly, the source of all other effects produced in the subject by quantity: hence, it was spoken of as the primary effect, and these others as

the secondary effects of that accident. The Schoolmen fought vigorously over this question. Almost everyone of the alleged consequences of quantity was set up by some Doctor as its primary effect. In St. Thomas's day, the controversy had not begun and, accordingly, texts of his are quoted in favour of several views.(7) A similar doubt hangs over the attitude of Scotus for the same reason. By degrees, the more unlikely theories were set aside on the grounds either of reason or of revelation. Thus, the majority of the Schoolmen refused to consider either local extension, or divisibility, or impenetrability, or measurability, as the essence of quantity: Christ's Body with Its quantity is present in the consecrated elements, whole in the whole and whole in such each part thereof; actual divisibility or impenetrability or measurability presupposes actual local extension; hence, the general view that none of these effects can be the essence or primary formal effect of quantity. The controversy was, thereby, narrowed down to two opposing theories: one asserting that quantity confers on substance distinct integral parts, and the other asserting that quantity confers on substance the extension of already existing integral parts. The first theory has been styled the Thomist (8) view because it was defended, mainly, by members of the Dominican order: it is, these Thomists claim, the obvious meaning of the more decisive texts in St. Thomas. The opposing theory (9) may be styled the anti-Thomist view: it is hardly in Scotus, but it was warmly espoused by his later disciples; it was fully developed by Suarez, and became popular with his disciples. Both theories agree on three points: they agree that integral parts are parts which, when taken together, make up the integrity of a substance, and which can be removed, of course within limits, without destroying the essence of the substance—for instance, the limbs of an animal, the branches of a tree, the corners of a stone; they agree that the reality or entity, underlying these integral parts, is not derived from the accident of quantity but from the substance and from it alone; they agree that substance, apart from the accident of quantity, is not divisible after the manner of a quantitative continuum. These theories differ simply on the issue, whether the internal arrangement of the integral parts of substance is due or is not due to the accident of quantity. Now, internal arrangement means simply the entitative distinction of these integral parts, not their separate existence as brought about by the application of real limits. Thomists say this internal arrangement of the integral parts is due to quantity, and is its essence. Anti-Thomists say that this internal arrangement exists in substance, apart from, and prior to, quantity.

According to the Thomists, substance of itself has merely the two essential constituents, primordial matter and substantial form: it has of itself no actual integral parts, and is not divisible into smaller portions each of which would contain the two essential

constituents ; it has of itself nothing more than potential integral parts, that is, the root and need of these parts. Apart from quantity, then, substance is a composite of primordial matter and substantial form which, while possessing within itself all the substantial entity of integral parts, has not these parts as entitatively distinct : apart from quantity, the entity of these parts is not actually distinct, one from the other, and not even God could divide an unquantified substance into several parts of the same kind. Substance of itself is indivisible : not because it is of itself a point, for it is a physical substantial reality ; not because it is a spirit, for it is made up of primordial matter and substantial form, and it has in addition the root and need of integral parts ; but, because it is a reality which, though capable of receiving into itself the entitative distinction of integral parts, has not of itself that entitative distinction. The accident of quantity introduces into substance the distinction of integral parts, placing them one outside the other within the whole. This mutual extraposition of the parts within the substance is not to be confounded with actual local extension : hence in the Thomist theory, a body can be actually extended within itself apart from actual local extension. This, then, is the essence or primary effect of quantity : the secondary effects of quantity—the occupation of space and, therewith, actual local extension, quantitative divisibility, measurableness, and impenetrability in regard to other quantified realities—follow naturally from it.

The strongest argument in favour of this theory is its harmony with the theology of the Eucharist. Christ's Body has its quantity in the Eucharist by the mere fact that He has therein the integral parts of His Body placed one outside the other in reference to the Whole ; and as diffusion through space or local extension is not of the essence of quantity, Christ's Body, even though quantified, can be whole in the whole Host and whole in every part of the Host. Thomists can say, therefore, that Christ's Body in the Eucharist preserves its own real quantity because It has the entitative distinction, the extraposition, the orderly connexion of organs and limbs : the presence of Christ's proper figure in the Eucharist, apart from Christ's size, emerges as a natural sequel of the Thomist theory of quantity. The Thomists rely, also, on arguments from reason. They argue that if substance has of itself, as their opponents say, distinct integral parts there would seem to be no need of the accident of quantity to account for those other consequences on which these opponents rely as proofs of the presence of that accident : if substance has of itself distinct integral parts, then, these parts would of themselves be naturally juxtaposed outside one another ; if substance has of itself this juxtaposition of integral parts, these juxtaposed parts would of themselves postulate local extension ; and when their opponents urge that quantity is necessary because the integral parts of that accident are of themselves impenetrable, Thomists retort that there are no grounds for conferring impene-

trability on the integral parts of an accident, and denying that impenetrability to the integral parts of a substance.

Anti-Thomists urge two chief objections to this theory. They urge, first of all, that quantity which is only an accident confers in the Thomist view something substantial, namely, the substantial entity of the integral parts: those parts are substantial, but quantity cannot formally give anything substantial. Thomists reply that the reality underlying the integral parts is, indeed, substantial for it is the composite substance, but that the distinction, the juxtaposition, the orderly connexion of these parts is brought about by the accident of quantity: of itself, the substance has only the potency of such parts; quantity reduces this potency to actuality, and thus makes these integral parts exist as distinct, orderly, and juxtaposed within the substance. Most Thomists are content to interpret this potentiality of integral parts in substance as implying that such parts, prior to the advent of the accident of quantity, are present merely radically and *exigitive*. John of St. Thomas goes further: he interprets this potentiality as implying that the whole reality of these parts is present, prior to the advent of the accident of quantity, but present in a state of fusion and confusion because ordered unity between them is lacking. A second difficulty urged against the Thomist theory is that no analogy can be given elsewhere of the separation alleged in Christ's Eucharistic Body between internally extended parts and the occupation of different spatial positions by such parts: in other words, that the Thomists explain one mystery by propounding another which is equally obscure.

On account of these objections and of arguments which shall be given later, anti-Thomists contend that substance of itself has not merely essential, but also integral substantial parts: it has of itself the two essential constituents, primordial matter and substantial form; and it has of itself, also, integral parts that are entitatively distinct. This possession of distinct integral parts is generally spoken of as entitative composition of substance: it implies the presence of these parts, their distinction from and their orderly union with one another: it does not imply either the mutual juxtaposition or impenetrability of these parts. And since substance has of itself integral parts which are distinct from one another, the parts are, at least absolutely, separable from one another. This multiplicity of integral parts within substance, prior to the advent of quantity, is also spoken of as entitative extension of substance. Anti-Thomists insist, however, that substance, even with its distinct integral parts, is a reality outside the genus of qualified continua: it has, indeed, integral parts but those parts are intelligible, not sensible, and their distinction from one another can be thought, not perceived. Hence substance apart from quantity is not quantitatively divisible: but if you mean by division merely the separation of one part from another or a mutual discontinuity of parts, God can certainly divide up these integral parts of substance into lesser parts.

Now, the anti-Thomist holds that the accident of quantity introduces mutual juxtaposition and impenetrability into these already existing integral substantial parts. That accident has accidental parts of its own which are distinct from and connaturally impenetrable with one another, and therefore, placed one outside the other: these accidental parts inhere in the various integral parts of the substance, and connaturally bestow on these latter actual local extraposition. But since this actual local extension can be prevented preternaturally, quantity primarily confers on substance merely a proximate and positive tendency towards local extension: proximate, because the integral parts of substance have of themselves a remote tendency towards extraposition; positive, because the presence of this accident confers on the integral parts of substance a real claim to extraposition. The various secondary effects of quantity follow naturally and easily from this primary effect.

This anti-Thomist theory also fitted the current theology of the Eucharist. Christ's Body with its quantity is present in the consecrated elements, for the essence of quantity is a proximate and positive tendency towards local extension: God's miraculous power prevents actual local extension, and thus, Christ's Body can be whole in the whole Host and whole in every part of it. But whereas the Thomists can allow actual internal extension to Christ's Body in the Eucharist, their opponents cannot. Anti-Thomists explain the presence of Christ's Body in the Host after the analogy of the presence of a spirit in space: Christ's quantified Body is present in the Host without actual local extension owing to a miracle. They enlarge on this explanation in phrases suited to their own theory: the "quantitative order" of the parts of Christ's Body is present in the Host, but not the "situate" order: the "quantitative distance," of these parts is present because one part is not immediately but mediately united with some others, but the local distance of these parts is not preserved; the "organic figure" is present because its parts are united in a determinate order and postulate extraposition in that order, but the "situate" figure is not actually present.

Anti-Thomists claimed to be driven to this view of quantity by the insuperable nature of the objections that could be urged against the Thomist view. They alleged also a number of arguments in favour of their own view. Often they begin, as do the Thomists, with the plea that if you grant such-and-such to be the essence of quantity, you explain satisfactorily the secondary effects of quantity and, also, all pertinent corollaries of the Eucharist. That kind of plea, unfortunately, tells equally well in favour of both disputants. The reason is obvious: at this stage, Thomist and anti-Thomist are really extracting from their respective juggler's box the contents each of them had previously hidden therein; hence, this particular argument turns out to be in each instance merely a subtle reconstruction of the mental processes by which each party reached its view and, with dialec-

ticians of medieval calibre, there is rarely a logical flaw in such tactics. More marrow is discoverable in those other pleas of the anti-Thomist which have already been mentioned as objections: an accident cannot complete substance in any substantive way; besides, if integral parts be denied to material substance, the difference between matter and spirit dwindles almost to vanishing point. But if substance as such involves integral parts the better alternative is, say the anti-Thomists, our view. Eucharistic theology shows that the essence of quantity cannot consist in actual local extension. Quantity must, therefore, be either actual extension of the parts within the whole apart from local extension, or a proximate and positive tendency towards local extension. Anti-Thomists reject the first suggestion as unnecessary: if two bodies can by divine power compenetrate each other, *a pari* the integral parts of a quantified substance can so compenetrate one another as to remove all actual extension; again, spirit exists in space in an indivisible and a non-extended way, and God could miraculously grant this mode of existence to matter. They accept accordingly the second suggestion: quantity essentially confers on a substance a proximate and a positive claim to local extension. They were led in this way to set up a fundamental difference between two aptitudes for local extension: a passive and remote aptitude which is basal, and is of the essence of matter as substance: a positive and proximate aptitude which is found in matter only as a result of the presence in its substance of the accident of quantity; and for the purpose of emphasising the value of this accident, anti-Thomists taught this proximate and positive tendency towards local extension to be so real that God alone can prevent its realisation. This distinction of a twofold aptitude towards extension has ever been set aside by Thomists as indefensible. It is, Thomists urge, merely a feeble effort to disguise the genuine relationship between the view of Scotus and Suarez and that of the Nominalists: if substance has of itself any kind of genuine capacity for local extension, what is the need of this distinct accident called quantity which clearly does but duplicate this alleged genuine capacity? Anti-Thomists reply that substance for the Nominalists does not postulate for its own extension a distinct accident of quantity, because the substance and its quantity were identical; but substance for themselves does postulate a distinct accident of quantity, because for them substance has of itself only a remote tendency to local extension.

The Secondary Effects of Quantity.

By the secondary effects of quantity the medievalists meant, in practice, those consequences of quantity which are observable in natural bodies but are miraculously suppressed in Christ's Eucharistic Body. None of these secondary effects raised any big controversies. For all the Schoolmen local extension followed naturally on the reception by substance of quantity: quantity

rendered the integral parts of substance mutually impenetrable, and sets them one outside the other in space. Divisibility and measurability followed naturally on local extension : an extended body is both divisible and measurable. However, the medieval theory of impenetrability needs watching.

Impenetrability was said to be due to the formal causality of quantity. Experience, says St. Thomas,[10] proves that two bodies cannot occupy the same place. Some allege, he proceeds, that this mutual impenetrability is due to corpulency ; and by corpulency, they mean density or impurity, or corruptibility, or, at least, something special added to corporeity. But he rejects all those explanations of impenetrability in favour of the theory of Avicenna, which explains impenetrability by the suggestion that quantity confers on each part of the substance a position in space distinct from that occupied by its neighbour : when a substance becomes quantified, its various parts receive and hold different positions in space ; and the impenetrability, that exists between distinct substances, results from this impenetrability between the integral parts within each of them. " (Matter) is brought [11] into relation with place by the fact of having dimensions ; and hence, owing to the fact that matter is subject to dimensions, several bodies cannot exist in the same place." " That which [12] prevents (penetration) is nothing else that those dimensions by which corporeal matter is affected : for that which is directly, must be, necessarily, a cause in some genus. Now, distinct spatial position follows primarily and directly from dimensive quantity, for this latter is defined as quantity that has position. That is why the parts of a substance receive distinct spatial positions from the very fact that they are subject to dimensions : and just as the distinction of the different parts of one and the same body arising out of their distinct positions of space is due to dimensions, similarly, different bodies are distinguishable by those differences in location which they owe to their dimensions." Impenetrability is due, then, not to the efficient causality of an active power but to the formal causality of quantity : owing to the presence within it of this accident, the substance and its integral parts occupy distinct positions in space in such a way that no other material substance can enter therein. No other theory received much support in the School. Sometimes, indeed, this formal causality was spoken of as resistance, but the explanations given of the latter word leave no room for doubt as to the author's meaning. " In an action," writes St. Thomas,[13] " there may be resistance in two ways : first, on the part of the agent, when, for instance, his power is weakened by an agent to the contrary ; secondly, on the part of the effect itself, when it is impeded by a contrary disposition. In every action wherein the agent is not acted on, the first kind of resistance does not occur, but only the second. . . . But an effect is impeded more by the substraction of the power of the recipient than by way of contrary disposition." Suarez [14] is equally explicit. " One thing may resist another

in two ways: first, formally, by immediate repugnance; secondly, radically, and, as it were, by a diminution of the others' force. It is in this latter way . . . that amongst men one is said to resist another, if, by anticipating his aggressor, he inflicts a wound, cuts off the hand or diminishes in any other way the powers of that other. Hence, this kind of resistance is nothing else but an action. But the other kind of resistance does not consist in action. . . . Hence, neither of itself primarily, nor by any kind of consecutiveness, does this other kind of resistance proceed from an active power inasmuch as it is active. . . . With regard, therefore, to this form of resistance, it must be said not to consist in any positive action proceeding from the power that is called the force of resistance; but to consist rather in the privation of action. Hence, such resistance is rather impotence or incapacity of some kind than a power properly so called; wherefore, it should not be mentioned among the divisions of power. . . . It consists, accordingly, in some formal incompatibility or repugnance owing to which the action of the contrary agent is either impeded altogether, or is rendered more slow or more remiss. And, therefore, this actual resistance does not consist in any second actuality of a positive kind that comes from the resisting power; but rather in the absence or retardation or abatement of the contrary action. Hence, that kind of resistive power is not a faculty of any kind that is of itself directed towards absence or retardation of action: the reason is, that natural power is not directed of itself towards any kind of privation; and that is why we say, this (kind of resistive power) is not so much a power as a powerlessness and a kind of incapacity."

The Endless Divisibility of Continua.

Aristotle's teaching on the divisibility of continua may be summed up in two terse quotations [15]: "it is impossible to form a continuum out of indivisibles, e.g. a line out of points"; "it is manifest that every continuum is divisible into parts that are themselves divisible." This teaching was accepted with practical unanimity by the earlier Schoolmen [16]: for them as for him, a line was not resolvable into points, nor a plane into lines, nor a solid into planes; in each instance, however exhaustive the division of the continuum be, the resultant parts are extended in one or more directions and, consequently, capable of further division. The main medieval argument was a paraphrase of Aristotle's indirect proof drawn from the impossibility of constructing a continuum out of inextended points: were such points to form a continuum, they should either touch or not touch one another; if they do not touch, they are at a distance from one another and do not form a continuum; if they do touch, then since they are not extended and have no juxtaposed parts, they necessarily coalesce and, therefore, do not form a continuum.

"It is [17] impossible to construct a continuum out of indivisibles, . . . a line out of points, if the line be truly continuous and the point be truly indivisible. To begin with, the extremities of points cannot unite into one for an indivisible has no extremities distinct from parts which are not extremities. Neither can the extremities (of points) lie together side by side for whatever has no parts has no extremities—the extremity being necessarily distinct from that whose extremity it is." "Aristotle proves that a continuum cannot be constructed out of indivisibles either by continuity or contact. . . . For when one thing is made out of several either by fusion or by contact, there must be extremities either to be fused or to lie side by side. The extremities of points, however, cannot be fused for an extremity exists only where a distinction of parts exists, and there is no such distinction of parts in an indivisible. For a similar reason, one cannot speak of the juxtaposition of the extremities of points: there can be no extremity in what is indivisible, because the existence of an extremity implies the existence of a something else of which it is the extremity; but, this distinction of parts is unthinkable in an indivisible. Hence, our conclusion that a line cannot be constructed out of points either by fusion or by contact." [18] This same conclusion was reached by an analysis of the nature of continuity: the continuum is, as such, homogeneous—every part within it is extended in the same way as the whole; but the continuum as a whole is divisible; consequently each of its parts is divisible; and hence, a continuum is endlessly divisible. "It is true that a body is made less when some part of it is cut off, and that is why some imagine this kind of cutting will finally reduce the body to nothingness. That is not so: cutting never ends in nothing. The reason is that every part which results is still a body and, accordingly occupies, space: but, it could not do this except it also had parts into which it could be cut. Hence, by endless cutting, it can be endlessly lessened and, in that way, it can undergo a loss and approach to nothingness: for all that, it never actually arrives at nothingness." [19]

This early medieval thesis of the endless divisibility of continua was restricted to bodies when considered solely as extended. Thomists taught, for instance, that even non-living substances had a limit of smallness of size. "Although a body [20] is endlessly divisible from the mathematical point of view, natural bodies are not endlessly divisible. The reason is that, in a mathematical body, you have to think of nothing but quantity and that does not prevent division. But a natural form exists in each natural body, and that form postulates a certain fixity in quantity as well as in the other accidents." "A mathematical [21] body is endlessly divisible because extension is the only thing to be taken into account when dealing with it, and extension does not exclude infinite divisibility. A natural body with its form is not, however, endlessly divisible because when the utmost limit of its size is reached, it is forthwith changed . . . (by any further division)

. . . into another body." Despite a certain subtle dissent from this general teaching, Scotists [22] may be said, in practice, to be of one mind here with the rest of the School. Scotists denied, it is true, that non-living bodies postulated, in reference to generation, a fixed intrinsic parvity of quantity, but they admitted that definite size limits were necessary for the conservation and activity even of inanimate beings.

So baffling to the imagination are the consequences of this thesis of the endless divisibility of continua that some of the later Schoolmen [23] rejected it. These dissenters taught that continua was formed by the union of indivisibles: many holding these indivisibles to be finite in number; a few holding them to be infinite in number. Their main argument was the incredible results of the older view: who could believe that God or an angel might spend all eternity in breaking up a foot-rule and yet never arrive at a fragment that was not further divisible? further, God must know all the possible fragments into which a foot-rule is divisible and, therefore, its divisibility must somehow or other have a limit. They argued, also, that as a perfect sphere can touch a perfect plane only at a point, it follows that if such a sphere be so continually moved and rotated over a plane as to touch that plane everywhere, the sum of these points of touch gives the length and breadth of the plane. Finally, they insisted that lines are made up of points because the point is to the line what one is to the other numbers. Those later Schoolmen, who stood by the traditional thesis, made rather curt replies to these arguments: a man ought to be led by his intellect and not by his imagination—stick to facts and to principles, never recoil from the consequences of either or both; God knows facts and possibilities, not contradictions; perhaps the sphere touches the plane at every conceivable point, but points are not realities, they are merely mental abstractions, and the summation of abstract entities raises no difficulty against the endless divisibility of extended bodies—such was one reply to this sphere objection; the sphere at rest touches only at one point, but the sphere in motion touches in a continuous line—such was another reply; the final argument was usually rebutted by denying any parity—unity is the principle of number but points cannot be, as Aristotle's arguments prove, the principle of continuity.

A mediating theory which, Hurtado [24] says, was invented by his master, had only a short medieval vogue. It taught that continua were constructed out of distended points: the theory was, in fact, a revival of that Pythagorism against which Zeno had directed his dialectics. Continua were made up of points indivisible in themselves but virtually extended: each indivisible point occupies a certain volume of space and excludes, therefrom, all other points—somewhat after the manner, in which a spirit might occupy a space. A number of objections were urged against this third theory by contemporary opponents: this manner of occupying space is proper to spirits, and there is no

proof either of its necessity or its possibility in the case of matter; one might just as plausibly suggest that the whole universe is one virtually extended indivisible point; these points touch as wholes, and there is nothing to prevent mutual compenetration; these points occupy space and ought, accordingly, to be both sensibly percipient and absolutely unbreakable; points distended in three dimensions would form solids, but not planes nor lines, points distended in two dimensions would form planes, but not solids nor lines, points distended only in the dimension of length would form lines but not planes nor solids: finally, it was argued that the halving of a line made of three of these distended points, or the division into a proportional number of parts of lines of unequal lengths, was impossible. These objections scotched the theory. But it seems to have been killed outright in those days by an express prohibition of His Paternity, General Vitelleschi (1615-1645).

The Manner of Existence of Parts within a Continuum.

Continuity, in general, implies that dimensive quantity pervades a substance in such a way that its extended parts form a unitary whole: this continuity was said to be perfect when there were no pores within the extended substance; it was said to be imperfect when one or more pores existed within such a substance. A continuum—or continuous substance—is, then, a material substance whose parts hang together in unbroken unity: and in medieval days, sense-perception was accepted as the ordinary test of this unbrokenness. The nature of a continuum excludes genuine internal limits. There are ways, however, of introducing, into a continuum, limits that do not destroy its internal singleness: a flag may be painted with various colours; an all-white flag may be covered here or there by a hand or a book; finally, apart from colours or hand or book I may, mentally, contrast the top, the bottom, the right and the left, of the flag. "The separation [25] (of a part of a continuum from the whole) is rendered intelligible by any kind of marking. I can, for example, mark off by touch or by thought any special part and thus in a way divide the whole, and cut off a part from that whole, saying there is less whiteness in the part than in the whole." And apart from these methods of introducing external limits which did not destroy continuity, the visible molar continua of medieval physics were of course being constantly broken up into smaller separate units: stones into sand, logs into faggots, sheets into strips, and so on. Now, it was the common doctrine of the School that none of these methods of division produced the entity of the subsequent parts: division presupposes the entity of the parts, and merely destroys in one way or another the link between such parts. "A continuum is divisible into its internal parts," says Aristotle, but he adds elsewhere, "halves are in the continuum not actually but poten-

tially." "The parts of a line," writes St. Thomas,(26) "are not actually two but one: still, the line itself is potentially two and becomes actually two when divided. Mere division of a continuum produces these actualities: hence by dividing a line, nothing new is induced in the parts that are broken up; the same linear essence, which was previously actually one and potentially multiple, becomes actually multiple as a result of the division. . . . And the same is true of a stone or of a fire." "Similarly, when bodies are divided, two planes that previously did not exist begin *de novo* to exist." (27) Scotus repeats the same teaching: "The parts of a continuum had the same positive entity within the whole as they have later outside that whole: but, within that whole, these parts had such a continuity as excluded all actuality that would imply their being cut off (from one another), whereas, outside the whole, they have this actuality of being cut off from one another." (28) Richard of Middletown is equally explicit. "It must not be held that division gives to the essence of the part any reality which this part had not already: when one part is broken off from another, what happens is that its essence exists now as a whole whereas, previously, it existed merely as a part." (29) There was no divergence of opinion, then, in medieval days about the doctrine that the parts of a continuum existed prior to any kind of division.

But when the question was raised concerning the manner of existence of these parts, the Schoolmen divided into two camps: St. Thomas (30) and many Schoolmen held that, prior to division, the parts of the continuum were merely potentially distinct; Scotus,(31) Suarez and others held that, prior to division, these parts were actually distinct from one another. In its later stages, this controversy became extremely lively. Those who supported an actual distinction in post-Tridentine days appealed in defence of their view to the third canon of the thirteenth session. Then, not content with strengthening their metaphysics by this theological infiltration, they indulged roundly in abuse: Hurtado explains the existence of the opposing view by saying that just as no one is too ugly to find a lover, so no theory is too idiotic to find a defender; Arriaga speaks of the opposing view as, already, obsolete and antiquated; some Portuguese professors reject it as paradoxical, and speak of the arguments in its favour as deserving ridicule rather than refutation. The other side did not let this abuse go unanswered: Soares taunts Hurtado with the calibre of the Schoolmen who, in the past, defended this alleged fatuity; he reminds Arriaga that what is ancient is not, thereby, antiquated; he recalls to his Portuguese compatriots that the view, at which they scoff, was taught by the ablest scholastic Portugal ever produced, by him who was known in other lands as the Aristotle of Portugal, Fonseca; finally, he announces to all these epigones that, according to his information, the Thomistic view is nowadays the most prevalent in Italy, France and Germany. These epithets and retorts point to a

grim and earnest controversy. It is difficult, however, to discover any big issue behind it all. These disputants agreed that a continuum has parts; they agree, also, that prior to physical division none of the parts has genuine limits; they agree, moreover, that division other than physical introduces into a continuum a sufficiently useful means of marking off part from part; their bone of contention was the exact formula for that distinction of parts which existed prior to every kind of division in a continuum. The controversy was, then, more about words than facts. It must be remembered, however, that the peculiar nature of material continuity makes almost impossible the invention of words precise enough to describe the distinction of parts within it. A non-living continuum is a unique whole: it is through and through homogeneous, and on that account allows neither difference nor opposition between its parts; hence the difficulty of distinguishing within it the integral parts. The theory of potential distinction has much in its favour; firstly because, prior to either some kind of extrinsic designation or to physical division, no part of a continuum can be distinguished from any other; secondly, because were the parts actually distinguished they could be numbered, and then for those who admitted, as did most of the Schoolmen, the endless divisibility of continua, the parts of each finite continuum would constitute an actually infinite number. Further, if one recalls that this theory of potential distinction admits the presence of whatever entity is in those parts that can, in all the ways mentioned, become actual, all objections can be fairly countered. A Thomist can speak of parts within a continuum because, prior to either designation or division, he admits potential parts; he can speak of the halves of any body because he mentally divides it; he can speak of entitative or material parts as actually present, prior to either designation or division, because he admits as pre-existent in the continuum the reality underlying all possible parts; he can refuse to speak of these entitative or material parts as actually distinct at this prior stage, because that actual distinction implies some kind of limit; he can refuse to admit the identity of these entitative parts at this prior stage, because a continuum differs from an unextended substance precisely in this fact of having parts outside parts, even though these parts are not actually but potentially distinct. In short, the Thomists advocate for the parts of a continuum a mean between actual identity and actual distinction, a real potential distinction: a real distinction because the continuum has parts outside parts within itself; a potential distinction because, prior to extrinsic designation or to physical division, these parts are not actually distinct. And this real potential distinction acts as a solvent of all objections. Suarez urges the mere fact of one entitative part not being another as sufficient proof of their actual distinction. Thomists explain this lack of identity by the peculiar kind of potential distinction which is verified of parts within a continuum, and only

of them. Suarez urges that this potential distinction must be either real or virtual, and that as it cannot be virtual it must be real : Thomists allow that this potential distinction is not virtual in the sense in which man's sentient soul is virtually distinct from his rational soul, but insist that it is a virtual distinction in a unique sense of its own for the reason that it is founded on that unique reality, material continuity, which excludes both the identity and the actual distinction of the parts present in it. Others urge that divisibility is an evident sign of an actual distinction, for, otherwise, a reality could be divided from itself. Thomists retort that their real potential distinction excludes mutual identity and accounts for divisibility. Others urge that the head, hands, trunk, and legs of a statue are surely actually distinct from one another, and from the whole figure : Thomists assent, but contend that these actual distinctions are consequent on the various shapes of these parts, that is, on the introduction from without of a number of limits. Others urge that the essence of continuity consists in the juxtaposition of parts, and that juxtaposition implies actual distinction : Thomists grant the first proposition, but insist that the potential distinction of parts suffices for juxtaposition ; they add, also, that in defending continuity, our minds inevitably introduce limits into an object which is, in itself, nothing more than an extended, homogeneous, single substance.

Indivisibles as Links and Limits in a Continuum.

The greater Schoolmen and the majority of their disciples refused, as we saw, to admit that continua are made up of indivisibles of any kind. But controversies arose as to the nature of those indivisibles that are conceivable as internal links or external limits of formally extended bodies. These indivisible links or limits were points, lines, and surfaces. The Schoolmen distinguished between boundary and connective indivisibles : boundary indivisibles are those that terminate any special dimension—external surfaces terminate solids, enclosing lines terminate surfaces, external points terminate lines ; connective indivisibles are those links that are thought of as existing within, and holding together, the integral parts of a continuum—a line is thought of as having its parts held together by points, a surface by lines, a solid by surfaces. These common starting-points led to controversy regarding the nature of indivisibles. The genuine issues at stake were crystallised in two theories. Scotus,[32] Suarez, and many others held that indivisibles were positive realities distinct from their continua, capable by divine or angelic power, both of being separated therefrom and of being kept in existence in this state of separation : for them, the boundary indivisible of a solid was apparently a subtle indivisible membrane surrounding that solid, the boundary indivisible of a surface a series of subtle indivisible threads, the boundary indivisibles of a line

two indivisible spheres at each extremity; analogously, the connective indivisibles within solids were surfaces without depth, the connective indivisibles within surfaces lines without depth and breadth, the connective indivisibles within lines spheres distinct from the line itself and thought of as mathematical points. Albert the Great,(33) St. Thomas, Durandus, Ockham and some later medievalists held that indivisibles were negativo-positive realities, that is, merely the abstract limits of their various continua and, therefore, absolutely inseparable from these continua: for them, a boundary surface was a solid thought of as having length and breadth apart from depth, a boundary line was the surface of a solid thought of as having length without breadth, a boundary point was the extremity of the line of a solid thought of as having position without magnitude; analogously, connective indivisibles were not positive realities distinct from the parts they were alleged to hold together—connective points and lines and surfaces do not exist as physical separate realities within bodies, they exist only as objects of thought for our minds. On account of this theory their opponents accused these writers, and especially the Nominalists among them, of decrying points and lines and surfaces as fictions. If this accusation means that Nominalists put these indivisibles on a par with hobgoblins and mermaids, I should think it untrue. The Nominalists never seem to have denied that geometry had a real basis for its objects of study in the position, length and breadth of solids: what they did deny was that points and lines and surfaces were positive realities physically separable by divine or angelic power from bodies, in other words, the alleged spheres and threads and membranes of their opponents; they seem to have held that points and lines and surfaces exist formally only as mental concepts, but they apparently allowed that all these were realities in the sense of being genuine aspects of actually existing bodies. For the Nominalists, points and lines and surfaces cannot exist apart from solids, yet, our intellect does not lead us astray in conceiving these indivisibles as abstractions; these indivisibles have a real existence but not in the insulation of their ideal form; a view that suits admirably the medieval Nominalistic theory of knowledge with its blend of conceptualism and sense-realism.

Four chief arguments were advanced in favour of the separable reality of these indivisibles: there must be something to hold together the various parts of continua, and that something must needs be distinct from what it holds together; a continuum must be limited by something positive, and that something can be only a distinct indivisible; one part of a line is really distinct from another part, and that part which is at either extremity is, therefore, really distinct from all intervening parts; an indivisible cannot be identical with what is essentially divisible—a formally extended continuum. The disputants, on the other side, made short work of these arguments. If the parts of a line are joined together by points, the parts of a surface by lines, the parts of a solid by

surfaces, then, these connected parts because divisible must consist of smaller parts, and the question arises whether these smaller parts are or are not held together by distinct indivisibles: if they are not, there is no reason why larger parts cannot be held together without these indivisibles; if they are, then a similar question can be raised *ad infinitum* about the parts of these smaller parts; the consequence is, that you must stop somewhere at divisible parts which are held together without indivisibles, or you have to envisage a continuum as a series of indivisibles linked together by other indivisibles. The second argument is countered by the plea that boundary indivisibles are, according to the point of view, positive or negative realities: positive, inasmuch as they are extremities of a real body; negative, inasmuch as they are a denial of further extension. A similar reply is made to the third argument: a boundary indivisible, when considered both positively and negatively, is certainly not identical with that continuum which it limits: and when considered solely in its positive aspect, it is merely a way of thinking about one particular part of that continuum. In reply to the last argument, it was allowed at once that the same reality cannot in itself be divisible and indivisible: it was urged, however, that the threefold dimensions of solid bodies offer to our minds a basis for marking off therein aspects that prescind from some or all of these dimensions. Side by side with these refutations of their opponents' arguments, Ockham's razor figures everywhere in this controversy: entities are not to be needlessly multiplied, and every purpose, for which both kinds of indivisibles were postulated, was sufficiently attained without them. Boundary indivisibles are but mental aspects of the various extremities of solids: a boundary point is a limit to bodies that is thought of as position without magnitude; a boundary line is another kind of limit to bodies that is thought of as length without breadth and depth; a boundary surface is a third kind of limit to bodies that is thought of as length and breadth without depth. There is even less use for distinct connective indivisibles: the parts of a continuum are immediately and of themselves united—otherwise, a continuum must be formed of indivisibles.

CHAPTER VIII.

THE ARISTOTELIAN SCHOOLMEN ON THE QUALITIES OF MATTER.

QUALITY was for Aristotle and the Schoolmen an ultimate reality: a something too elementary, St. Thomas warns us, to be strictly definable. Aristotle himself (1) had spoken of quality as any kind of distinctive trait: any reality that made a thing be such and such. This wide definition enabled him to talk sometimes of the substantial form as a quality. But the Schoolmen (2) gradually restricted the category of quality to accidental forms. They were even unwilling to include under this category all the accidental forms. They excluded from the category of quality the accident of quantity and all its formal consequences, on the ground that quantity simply extends bodies and makes them fit for the reception of other accidents. They excluded, also, from the category of quality the remaining categories of accidents, action, passion, etc., on the grounds that these classes of accidents determine the substance externally rather than internally. The characteristic mark, then, of quality for the School, is that it is an accidental form which exists primarily for the purpose of disposing and perfecting internally a substance. "Quality (3) is an accident that completes and perfects a substance both in existence and in activity." "Quality is an accident (4) that modifies or disposes a substance within itself." "Although all the accidents (5) are in a sense attributes of substance and are added thereto either on account of some imperfection in it or for the purpose of supplying some defect in it, still, there is this peculiarity about quality that it is, of its very nature, intended to adorn and perfect intrinsically a substance in order to fit this latter adequately for its existence and its activity. . . . It is no use to object that some qualities are unsuitable to some substances, for the existence of these qualities in such substances is purely incidental: of their nature, these qualities were made as part of the complete equipment of some substance."

Qualities were variously classified by Aristotle and the School. These classifications do not concern our present topic: the nature of material qualities. In a previous chapter, the medieval theory of a real distinction between an inanimate substance and its material qualities was expounded. Our present chapter on the

nature of material qualities centres, wholly, on a different and no less famous doctrine of the School: the distinction as formal accidents between a material quality and all quantitative forms of reality whether at rest or in motion.

Astronomy and Alchemy.

Medieval speculation concerning material qualities was based, mainly, on the natural science of Aristotle. It is true that the Schoolmen admitted in Astronomy and in Alchemy current post-Aristotelian doctrines in natural science. But these post-Aristotelian doctrines involved no fundamental breach with the teaching of the Stagyrite.

Medieval astronomy was an amalgam of Aristotle, Hipparchus, Ptolemy and Alphonso of Castile.(6) It differed from that fashioned by Aristotle in two respects: the number of the principal spheres, and the introduction of epicycles and eccentrics. Aristotle admitted only eight principal spheres: one each for the Moon, Mercury, Venus, the Sun, Mars, Jupiter, Saturn, and the fixed stars. Medievalists admitted two principal spheres outside these eight: a ninth to account for what was alleged to be the phenomenon of trepidation; a tenth to account for what was known as the precession of the equinoxes. And beyond these movable spheres lay the Empyrean, the motionless heaven, the abode of God and His angels and the glorified saints: a heaven beyond which and above which there is nothing; a heaven which is known only by revelation. Again, Aristotle had postulated an extraordinary number of minor spheres to account for the wanderings of the planets. The growing complexity of this hypothetical machinery led the Schoolmen to prefer the later theories of eccentric and epicycles: for instance, in the sixteenth century, when Fracastorius tried to revive the Aristotelian scheme, he found himself obliged to postulate as many as seventy-nine spheres; on that account, the majority of the Schoolmen preferred to accept the Ptolemaic scheme of eccentrics and epicycles. In the theory of eccentrics, each planet was supposed to be subject to two influences of revolution besides, of course, the diurnal rotation common to all the heavenly bodies: a circular movement of the planet itself round the centre of the earth from west to east; a circular movement of its eccentric not about the centre of the earth, but about some different central point and in the opposite direction. This theory was invented by Apollonius of Perga (*c.* 230 B.C.). He soon abandoned it in favour of a more celebrated theory that dominated astronomy for more than 1700 years: that of epicycles. The epicycle was a small revolving circle to the circumference of which the planet was supposed to be attached: the centre of this smaller sphere was situated at a fixed point of the principal sphere of that particular planet; this smaller sphere rotated round an axis passing through this centre; finally, the principal sphere was revolving round the

earth, either about its centre or, as an eccentric, about some other centre. Ptolemy (*c.* 155 A.D.) accepted, in principle, these two theories: by a combination of the opposite movements of epicycle and eccentric, due regard being had to their relative velocity and the magnitude of their diameters, he contrived to account fairly well for the more obvious phenomena of planetary motions. But, as in the case of the Aristotelian hypothesis of revolving spheres, the progress of observation led to the need of imagining epicycle within epicycle until Ptolemy's planetary scheme became as intricate and as cumbrous as Aristotle's. During the middle ages, however, Aristotle, as modified by Hipparchus, Ptolemy, and Alphonso, reigned supreme in astronomy.

Medieval Alchemy was mainly interested in the search for the philosopher's stone. Its interest for the metaphysician lay primarily in the dominant view that all bodies were composed of mercury, sulphur, and salt. But, in those days, no one dreamt of interpreting that suggestion as a rejection of the theory of the four elements. St. Thomas (7) and other Schoolmen state expressly that the theory of the alchemists is admissible if it means that mercury, sulphur and salt are derived ultimately from the four elements: and no alchemist of these early centuries set up any claims antagonistic to Aristotle. Hence, despite the advances made by Ptolemy in Astronomy and by the alchemists in Alchemy, the natural science of Aristotle was the accepted basis of medieval cosmology.

At first sight, it would appear that the Aristotelian doctrine of the origin of all non-living substances out of the four elements opened up the way for extensive medieval study of non-living compounds. This hope is not fulfilled in the treatises of the Schoolmen. They knew little about the inner physical structure of non-living compounds; they were content to distinguish between perfect and imperfect mixtures; when they speak of perfect mixtures, they refer by choice to the parts of living substances—skin, bone, flesh, etc.; when they speak of imperfect mixtures, they refer by choice to the obvious facts of metereology—thunder and lightning, clouds, hail, sleet, snow, comets, etc.; in short, their treatment of non-living compounds is restricted to a treatment of their qualities as perceived, or inferable from their action on our senses or on one another, and their chief theories in Cosmology are based on facts derived from the study of the four elements and of the four qualities of Aristotle. There is no mystery, then, about their method of discovering qualities in non-living bodies. Trust in the veracity of the senses and of the intellect was their guiding principle. Our senses make us aware of one group of qualities, the sensible qualities of matter: the proper sensibles or qualities which are known to one, and only one, of our external senses—tangibles, colours, savours, odours and sounds; the only other qualities known as sensible are figure or shape in all bodies, light in heavenly bodies with its effect of brightness in terrestrial bodies. Our intellect makes us aware of

other material qualities which are hidden from the senses, and are known as virtual or occult: these virtual or occult qualities were not of much interest to the School, and, apart from their discovery by the intellect, were discussed after the analogy of the sensible qualities. This meagre list contains every quality that figures prominently in medieval Cosmology. Meagre as it is, the development of its contents in opposition to the kinetic theory of Democritus led to a robust and unmistakable theory of material qualities.

The Medieval Distinction between Primary and Secondary Qualities.

A distinction (8) was made within the proper sensibles between primary and secondary qualities. Primary qualities were said to be irreducible and prolific: they did not come from other qualities; they were the scource of other qualities. This division occurs, first, in reference to the tangibles. There are fourteen tangible qualities: heat, cold, dryness, moisture, gravity, levity, hardness, softness, stickiness, brittleness, roughness, smoothness, density and rarity. Four of these fourteen are primary: heat, cold, dryness, moisture. Thickness, brittleness, and hardness are said to be secondary qualities derived from cold. Thinness, stickiness and smoothness are said to be secondary qualities derived from moisture. Levity and gravity, density and rarity proved a puzzle to those writers who are sticklers for a theory of four primaries whence originate all other qualities: some of the Schoolmen put these four in a class by themselves, on the ground that they play no direct part in the processes of substantial change; others frankly acknowledge the impossibility of deriving them from the primaries, and classify them as neutral, that is, neither primary nor secondary. The division into primary and secondary qualities is said, also, to fit the other proper sensibles: colours, savours, odours and—sometimes—sounds are said to be secondary qualities derived from the primary tangibles. The Schoolmen are aware, and on occasion make handsome acknowledgment, of the origin of varieties of colours, savours, odours and sounds from mixtures of their respective fundamentals: colours form a series of which black and white are the end-points; savours, a series of which sweet and bitter are end-points; odours, a series of which the agreeable and the disagreeable are end-points; sounds, a series of which musical and non-musical undertones are end-points; and all intermediate colours, savours, odours, sounds arise, according to Aristotle and the School, out of a mixture of these end-points. But this question of the production of intermediate colours, savours, etc., by mixture of their respective end-points was overshadowed in medieval days by the more difficult question of the origin of colour, savour, odour and sound from the four primary tangibles. This eduction did not prove as easy for the Schoolmen

as Aristotle's passing references suggested : a fair unanimity of view obtained about savour and odour ; but differences of opinion arose and stayed about colour and sound. Savour was generally held to be a secondary quality due to a mixture of the primary qualities in which the hot and moist are dominant but in which the hot is the more dominant of the two. Odour was held to be a secondary quality due to a mixture of the primary qualities in such proportions that the hot and the dry were dominant. As regards colour, some of the School held with Plato that colour was merely light received into the surface of opaque bodies : the more prevalent view was, however, that colour was a quality permanently existing in a body and resulting, therein, from the mixture of the four elements. Sound proved in this connexion a genuine stumbling-block : some held it was mere vibration, but the majority held it was a quality distinct from vibration ; and those who held it was a distinct quality failed to agree about its subject—some suggesting the vibrating body, others the intervening medium, and others both of these. This sketch will impress on the reader the overwhelming importance attached by the School to the four primary qualities. This importance is, emphasised also, by the Aristotelico-Scholastic teaching about the common sensibles. The common sensibles are aspects of matter apprehended by more than one of our external senses. Both Aristotle and the Schoolmen deny that these common sensibles are qualities.(9) Aristotle, in one place, enumerates them as five—size, figure, motion, rest, number ; elsewhere, he adds unity ; farther on, he adds the rough and the smooth, the acute and the obtuse. But he reduces unity to number, and the rough and smooth, the acute and obtuse to figure : in another place, he reduces all the five to motion ; and finally, he virtually admits that the common sensibles are not properly objects of sense at all. The Schoolmen followed this lead. St. Thomas regards all the common sensibles as modifications of quantity or the continuous ; and therewith they cease for him and his successors to be qualities.

The Medieval Theory of Sense-perception.

The Scholastic theory of the proper sensibles was developed in opposition to the kinetic theory of Democritus. Democritus (10) declared those sensations that are special to each of the five external senses false, on the grounds that they do not represent reality as it exists outside the percipient. " By convention there is sweet, by convention there is bitter ; by convention there is warm, and by convention there is cold ; by convention, there is colour. But, in truth, there are atoms and the void." . . . " By the senses, we in truth know nothing sure, but only something that changes according to the disposition of the body, and of the things that enter into or resist it. " Truth is in the depths " . . . " There are two kinds of knowledge, the

true-born and the base-born. To the base-born belong all these: sight, hearing, smell, taste, touch. The true-born is quite apart from these." Fragments of this kind leave no doubt on any reader's mind as to the Democritean theory of the proper sensibles: what really exists is an infinite number of atoms without either colour or sound or smell or taste or even tangibles, except of course extension and mobility. Aristotle, divining in the author of this theory a foe with a future, devotes several of his chapters on the proper sensibles to criticism and rejection of the view of Democritus. The School followed suit: they reject root and branch the Democritean explanation of the proper sensibles; in other words, they reject the distinction made later by Descartes and Locke between the primary and secondary qualities of matter. Aristotle and Schoolmen use the same language—primary and secondary qualities—as do these moderns: but, behind this identity of phrase, lurks two opposing and irreconcilable meanings. The full discussion of this topic belongs to Psychology: here, I shall recall only its outline for the purpose of expounding the medieval Cosmology of the proper sensibles.

Sensation is, for the School, a complex process by means of which the percipient is affected by an external object in such a way that his sense organs acquire for a time, as far as the nature of the percipient permits, the quality which exists in the external object. Moreover, the medievals (11) believed that this assimilation required the intervention of a medium between the sense organ and the proper sensible: facts prove, they alleged, that, when the proper sensible is in immediate contact with the sense organ, sensation is impossible. There are, accordingly, three factors in these sensations: the proper sensible; the medium; the sense organs of the percipient. And there are three processes: the action of the proper sensible on the medium; the action of the medium on the external sense organ; and finally the conscious reaction within the percipient, a process that, on the Aristotelico-medieval view, occurs in an internal sense organ known as the common sensory.

The first factor (12) for the perception of a proper sensible is the existence of such a sensible as an extra-mental reality outside the percipient: vision does not see itself, it sees colours. If matter existed while percipients did not, sensation would not occur but those extramental realities, which cause sensations and which are reproduced in sensations, would for all that exist. Sensation is not the sensation of itself but of something distinct from itself: and this distinct reality must exist prior to sensation for the simple reason that, whatever causes change is necessarily prior to that which is changed, a principle of universal application and verified, accordingly, even of correlative terms such as the proper sensible and the corresponding sensation. Of themselves, our external senses exist only in potency to sensation: they can no more become actually sentient apart from the stimulus of their respective external objects than a log of wood can begin to

burn of itself apart from contact with fire. Every thing that is in potency can be acted on and changed only by something actual and active : that is why our senses need the stimulus of the proper sensibles ; and, as we shall see, the result of this stimulation is to originate within them a transition from potency to actuality in virtue of which they become like the proper sensibles.

The first process (13) in this theory of sense-perception is confessedly perplexing for the psychological historian : happily, we are not engaged on his task, and we can be content here with alleged facts and probable interpretations. The alleged facts are the necessity of one or more special media for each of the proper sensibles : extrinsic media, air and water between colour and eye, sound and ear, odour and nose ; intrinsic media, the surfaces of the organs between tangibles and the organ of touch, savours and the organ of taste. This bald statement conceals, as every psychologist knows, a nest of worries. The worst of these worries arises out of the attempt to probe the kind of change wrought in the medium by the proper sensible. The purpose of that change is obvious : the transmission through the medium to the sense organ of the form of the proper sensible. But what is the nature of this change which is described, in the language of the School, as an intentional form, a *species intentionalis?* It is hard to say what the adjective " intentional " is meant to convey in this context : extrinsic media like air and water are not in any sense physiological or psychical ; then, this intentional form can hardly be the formal proper sensible because the medium, and not the formal proper sensible, is, for medievalists, in immediate contact with the external sense organ ; all that can be said is, that this intentional form must be some kind of effect temporarily produced in the medium by the proper sensible owing to which this medium is capable of producing in the external sense organ the sensible form of the proper sensible, the medieval *species sensibilis*. This vague interpretation of the intentional change wrought on the medium by the proper sensible, for the purpose of rendering this medium fit for its rôle in the process of sensation, must suffice : all the cosmological reader needs to remember is that the intervention of the medium was essential, but did not interfere with the accuracy of sensation.

The next process (14) is a passive state of alteration set up in the external sense organ by the proper sensible acting through the medium. This process results in a stamping by the proper sensible on the sense organ of a sensible form of itself : the *species sensibilis* of medieval psychology. The sense organ receives into itself the actuality of the proper sensible exactly as this latter exists formally in its natural substrate : the sense organ adds nothing to, and subtracts nothing from, the proper sensible ; it reproduces the proper sensible as accurately as a mirror reproduces the face of a man who is gazing into it. The explanation of this actuality is that each sense organ is in potency towards its proper object, and accordingly, is capable under normal con-

ditions, of mirroring its proper sensible. So perfect is this likeness between the sensible form within the sense organ and its prototype or proper sensible existing outside the percipient, that the actualities of both are in one sense identical: identical, not in the sense that the actuality of the proper sensible in its numerical identity passes over to the sense organ; but, identical in the sense that these two numerically distinct actualities are of the same nature, for each sensible form is the facsimile of its proper sensible; colour, for instance, has when perceived a twofold existence, a natural existence as proper sensible in the coloured object, and an intentional existence as sensible form in the sense organ of the percipient. In his anxiety to emphasise this likeness, Aristotle had gone so far as to suggest that the eye, when perceiving colour, became, by reason of the presence within it of this sensible form, coloured itself. St. Thomas discounts this Aristotelian phrase as a slight exaggeration, but grants that, as the eye has this copy of the external colour and as the spectator is thereby likened to the coloured object, you may, in a sense, speak of the spectator's eye as coloured: and he adds that a similar likeness is reproduced in every external sense organ during the process of perceiving its proper sensible. He follows Aristotle in pointing out, however, the difference in manner of existence that obtains between the copy within the sense organ and its external prototype: the sense organ receives into itself the form of the proper sensible apart from matter, just as sealing wax receives into itself the shape of an iron or gold seal apart from the iron or gold. In all action, the patient receives the form of the agent: but this reception is, in sense-perception, different from that which happens in causality between non-living bodies. When a non-living agent acts on an non-living patient, the latter may be disposed for the reception of the resulting form in exactly the same way as is the agent, and may, accordingly, receive this form just as it exists in the agent: air heated by fire acquires a quality of heat of the same kind as that which exists in the fire. Proper sensibles can not be received into our sense organs after this fashion: our eyes, ears, etc., are living tissues, and do not offer the newly-born form that kind of substrate which its progenitor has outside us; the consequence is, that the copies of these proper sensibles exist within our sense organs in a manner wholly different from that in which their prototypes exist in their natural substrates; the prototypes have their natural reality, their copies have a "spiritual and intentional" reality. That is the reason why, although the passive stage of change within the sense organ implies the presence of an actuality similar to that of the proper sensible, our sense organs are not affected exactly as are the substrates of the proper sensibles: the eye, though receiving into itself the sensible form of colour, does not become coloured; similarly, the process of perception does not make the ear sonorous, the nose odoriferous, the organ of taste savoury, the organ of touch any one of the tangibles.

This necessary passive stage is, in truth, the preliminary of sensation rather than sensation itself: sensation is "a change of the soul through the body." (15) The percipient reacts consciously under the stimulus of the proper sensible, and this act of consciousness is really the sensation. St. Thomas distinguishes expressly these two changes within the percipient: the change made passively by the proper sensible within the sense organ and resulting in the *species sensibilis* or sensible form; and the further change caused by the sentient reaction of the percipient, and resulting in the conscious perception or sensation in the common sensory. He insists, moreover, that our sense knowledge of the proper sensibles is *per se* infallible: and herein he is followed by most of the School.(16) Their argument was that no existing reality can be lacking in those perfections that are part of its essence: a man may have only one eye or one leg, but, as long as he is a man, he must have all the essential perfections of man—he must exist as a living, sentient, rational, substance; similarly, our senses may err regarding the common sensibles or the incidental sensibles, but they cannot err regarding their respective proper sensibles for the simple reason, that the chief purpose of each of them is to know its own proper sensible. Of course, certain conditions are indispensable for accurate functioning of these senses: medievalists were well aware of the illusions caused by jaundiced eyes, feverish palates, plugged ears. They allowed that sense inerrancy, in regard to the proper sensibles, was perfect only when both the sense organ and the medium were perfect. But they took up the reasonable attitude that the organ was healthy, and the medium normal, in the overwhelming majority of instances: the Power that begets percipient and percept does not abound in misfits; the universe is rationally constructed. The upshot of this medieval theory of perception is, then, that our external senses apprehend the proper sensibles exactly as these exist outside us. Proper sensibles exist as various qualities in bodies apart from, and independent of, the percipient: prior to perception, the external sense organ is potentially what its proper sensible is actually; actual perception implies, as a preliminary, a transition from potency to actuality within the external sense organ which results in making that organ actually, though intentionally, of the same quality as the external object; subsequent on this change in the external sense organ, a conscious reaction occurs in the common sensory in virtue of which the percipient perceives the proper sensible exactly as it exists outside him; under normal conditions, none of these processes can take wrong lines and, therefore, the resulting sensation is absolutely accurate in its report of the external reality.

This doctrine of the likeness between the proper sensible and the percipient's sensations is sometimes caricatured as implying that burning coal feels its own heat, snow its own cold, honey its own sweetness, etc. Such criticism is based on crass

ignorance of the medieval doctrine of sense-perception. The wheels within wheels, that function in the medieval theory, make this alleged identification of the extra-mental reality of the proper sensible and the sensation of the percipient utterly impossible. The Schoolmen insisted on the necessity of a medium between the proper sensible and the sense-organ; thus cutting off, from the start, any chance of confounding the extra-mental reality of the proper sensible with any of the processes that arise in the percipient. They distinguished, meticulously, between the action of proper sensibles on percipients and the action of proper sensibles on non-living patients: in other words, between the process of perception and the transient causality of one non-living body on another non-living body. They were careful to point out that, in certain instances of sense-perception, the proper sensibles—in particular, the tangibles and the odours—produce, within the external sense organ, not merely an intentional form but also a physical form. They never forgot to emphasise the distinction between the inanimate manner of existence of the proper sensible in its own substance and its intentional existence as a sensible form in the external sense organ of the percipient. Finally, they distinguished between both of these kinds of existence of the proper sensible and the conscious reaction of the percipient. That conscious reaction is the sensation: by means of it, the percipient knows directly and immediately the proper sensible as this latter exists in its own substrate; and that sensation is located by the School in the internal sense organ known as the common sensory. But despite all these differences between the extramental reality of the proper sensible and the sensation of the percipient, they did insist, for the reason already given, on the inerrancy of our perception of the proper sensibles. That is why they refused absolutely to identify the extramental reality of the proper sensible either with quantity or the local movements of merely quantitative bodies. For them, the proper sensibles were material accidents really distinct from the accidents of quantity and local motion.

The Democritean Theory of the Proper Sensibles.

Perception, for Democritus,(17) depended on the introduction of tiny effluxes through the organs of sense into the soul: these tiny effluxes were miniature likenesses of the atoms whence they came; the organs of sense were simply external passages, or thoroughfares, through which the effluxes entered the soul; and the soul itself was a group of atoms endowed with distinctive shapes, order, and motions. For him proper sensibles, as such, did not exist outside the percipient: the atoms and the void were the only extramental realities and neither of these had colour, sound, taste, smell or, apart from extension, proper tangibles. Proper sensibles exist, for him, only in consciousness: the extramental causes which arouse them are merely the grouping

and motion of atoms that possess no internal characteristics other than solidity, figure, size, and perhaps, weight. This kinetic theory aroused the fiercest antagonism both of Aristotle and of the Schoolmen. Before expounding the grounds of that opposition, it is well to be clear about what Democritus held. The extant account [18] of colour is rather full: all colours are compounded out of four, white, black, red, and green; whiteness, as an extramental reality, is merely the smoothness of certain atoms—smoothness prevents shadows but allows penetration; blackness, as an extramental reality, is merely the roughness of certain atoms—roughness allows shadows and prevents penetration; redness, as an extramental reality, is the sphericity of certain atoms; greenness, as an extramental reality, differs from these others in being due not to the shape of the atom but to a particular combination of the solid and of the void. Taste,[19] also, depends on difference of shape in the tasteless effluxes that stream off from the atoms: acid tastes are aroused by angular, small, thin shapes; sweet tastes by spherical shapes that are not too large; sour tastes by large shapes that have many angles but very little roundness; bitter taste by small, smooth, spherical shapes that have hooks attached to their spherical surface; and, so on, in ever-growing fancifulness. As for odours, Democritus does not seem to have given an explicit account of the atomic figures proper to each kind of odour [20]: he merely lays down that odour, as an extramental reality, is a fine sort of matter emanating from atoms and borne to the nostril; but he would contradict the fundamental thesis of his atomism, did he acknowledge odour as anything other than a subjective feeling of consciousness awakened in the percipient by odourless emanations. The same must be said of sound [21]: all Democritus says is, that sound is due to particles thrown off by the sounding body, and conveyed by the medium of the air to the ear, and through it to the soul; but, it is characteristic of his thoroughness to add that these particles enter the ear in conjunction with air fragments that resemble them in shape and size. These details of the Democritean theory of the proper sensibles were known, of course, to Aristotle. They were not known to St. Thomas and the School. But the Schoolmen follow the exposition and the criticism of Democritus that is embedded in Aristotle: and that account contains the heart of the problem.

The Aristotelico-Thomistic refutation of Democritus is directed, mainly, against his explanation of the primary tangibles because these qualities are, for Aristotle and the School, the only active and passive qualities which explain the generation and corruption of the four elements: "neither whiteness, nor blackness, nor sweetness, nor bitterness nor any quality other than a tangible produces the elements." [22] Failure here, then, spells failure everywhere: and that Democritus failed egregiously to explain the primary qualities, St. Thomas had no doubts. His starting-point is that for a Democritean the only extramental reality in

heat must be some particular shape in an atom.(23) Now if the hot be one shape, the cold must be a contrary shape; and if the hot and the cold are explained away as mere shapes, the other tangibles must be similarly explained away. But if, as a matter of fact, atoms are thus hot, cold, etc., they must act and react on one another—a consequence impossible for a Democritean: moreover, shape, as such, is neither active nor passive; again, if each atom has only one quality, atoms are not homogeneous and, being different in nature, are divisible; whereas, if each atom has several qualities, some passive and some active, contraries would be simultaneously present in the same indivisible atom. It is useless, St. Thomas adds, to try to reinforce this impossibility of activity in the Democritean atom by the assumption of a void: if bodies affect one another by contact, their action and reaction are due to the presence of active and passive qualities—apart from these, bodies might lie side by side for ever without influencing one another qualitatively; if bodies do not affect one another by contact, then, this assumption of vacant spaces, whereby their internal parts may come into contact, is worthless as a condition of action and reaction.

St. Thomas is fairly exhaustive, also, in his refutation of the Democritean theory of colour.(24) Democritus denies, he says, the genuine existence of colour (and other natural qualities of the same kind) as an extramental reality—colourless atoms arouse in us different colours solely because of changes of place or of attitude: further, Democritus teaches that the process of perceiving colour is due to the efflux of particles from the colourless object to the eye. St. Thomas does not waste time on explicit disproof of the first proposition: he is content with his refutation of the Democritean theory of those tangibles which were the basis of all colour; content, also, with the proof based on the inerrancy of normal perception as to the reality of colour as a quality that exists in the coloured object, light or no light, percipient or no percipient. But he dwells on the admissible consequences of of this efflux of colourless particles from objects to the eye: our eyes would be destroyed by this incessant bombardment of tiny particles; the loss of these emanating particles would gradually lessen and finally reduce to nothingness the size of all visible bodies; wind and rain would play tricks incessantly with these streams of emigrants and immigrants, and make accurate vision rare if not impossible; finally, colours are visible at distances so immense that they could never be travelled over by these alleged effluxes. In reference to savours, St. Thomas's rejection of Democritus is tersely stated.(25) The Democritean theory of savours as merely the shapes of atoms is impossible: the bitter is contrary to the sweet, but to which of the polygons, the bitter shape according to Democritus, is the sphere, the sweet shape, contrary?; again, shapes are infinite in number and, therefore, savours ought to be numerically infinite; and if Democritus pretends that savours are infinite in number, let

him or his explain why some of them are perceptible whereas the others are not. The absence of an explicit Democritean reduction of odours to shapes accounts probably for the absence of any explicit reference to this topic in the pages either of Aristotle or of St. Thomas. St. Thomas [26] has, however, a refutation of all the ancients taken from Aristotle: and this refutation certainly includes Democritus. All the ancients, he writes, were inclined to refer odour to exhalation of some kind; one group referring it to watery exhalation; another group to smoky exhalation; a third group to both one and the other. He rejects all three theories as unlikely: watery exhalation consists of water and this, being tasteless, is odourless; smoky exhalation cannot exist at all in water; finally, this exhalation theory of odours is analogous to the emanation theory of colours and is, therefore, to be rejected for the same reasons. Thus we arrive at last at that proper sensible which has ever been the joy of Democriteans and the torment of Aristotelians—sound. St. Thomas [27] knows well that a swinging bell puts air in motion exactly as a falling stone sets up ever-widening eddies in stream or lake.. He stoutly maintains, notwithstanding, that sound as a proper sensible is not merely the vibration of matter: when he finds Aristotle defining voice as the percussion of air, he explains away this definition as a definition not of voice but of its cause; voice is not percussion, but a sound caused by percussion. His view is that sound as a proper sensible exists not in the sounding body but in the medium—air or water: local motion, and it alone, is in the sounding body; sound, as quality, exists in the medium and has, therein, only a fleeting existence; its presence as proper sensible in the medium, air or water, is a result of the local motion of this medium. He allows that the colloquial language about sounds as sharp or grave suggests a connexion between sound and the speed or slowness of motion: this connexion is due, however, to the fact that motion is the cause of sound in the medium and that, when rapid, it causes sharp sounds, and, when slow, grave sounds. Of course, this explanation of sharpness and gravity refers only to instances where sound is caused by a single motion. Boethius pointed out long ago in his *Musica* that sound produced by several motions owe its sharpness to their frequency, its gravity to their fewness: hence it is that the more tense a string be, the more sharply it sounds when pulled. To sum up, sound is a proper sensible, local motion a common sensible: the one is known solely through the ear, and, regarding it, the normal ear cannot err; the other is known both by eye and by the organ of touch, and all sorts of mistakes are *prima facie* possible about it; sound and motion differ, then, not merely as sensations but also as external realities.

Two short sentences of Aristotle adopted by St. Thomas [28] embody the pith of their elaborate refutations of this Democritean theory of the proper sensibles: Democritus, in treating of sense-perception, proceeds quite irrationally for he represents all objects

of sense-perception as tangibles ; Democritus reduced the proper to the common sensibles for he reduces colours and tastes and the other proper sensibles to size and shape. The student of Aristotle and of St. Thomas cannot read these extensive chapters against Democritus without realising the chasm that separates these antagonists on this problem. There is, however, one passage in the midst of these refutations that has led astray some contemporary Aristotelian and Thomistic " dippers " ; writers who quote Aristotle and St. Thomas on a particular topic without taking the trouble to read all that these thinkers have said on that topic. Here is the passage as it stands in St. Thomas : and St. Thomas does but render in slightly different words the passage of Aristotle on which he is commentating. " The earlier speculators on nature," writes St. Thomas,[29] " were not correct in saying that nothing is white or black except when seen, that nothing is savoury except when tasted, and similarly in reference to the other (proper) sensibles and senses. . . . This doctrine of theirs is in one way right, in another way wrong. The sense organ and the sensible object have each of them a twofold meaning inasmuch as they may mean severally either that which exists potentially or that which exists actually. Now the teaching (of these earlier speculators) is true with reference to the actuality of the sense organ and the sensible object : but, it is not true with reference to the potentiality of the sense organ and the sensible object. But they spoke absolutely, that is without making a distinction, in reference here to topics that have more than one meaning." To a reader whose knowledge of St. Thomas's doctrine on the proper sensibles is limited to this extract, when torn from its context, this reads like an endorsement of the Democritean theory. But the reader who looks up this passage in the original realises at once that the context excludes any possibility of capitulation, and does but summarise, in highly technical language, the Saint's refutation of the Democritean theory. St. Thomas [30] had previously given two meanings for this word " actuality " as applied to the proper sensible. " Every (proper) sensible may be said to be in actuality in two ways. One of these ways of being in actuality occurs when the proper sensible is actually perceived, that is, when its form is in the sense organ : and in this way sound exists as an actuality when it is being heard. A second way of being in actuality, for the proper sensible, is existence in its own subject through that form by means of which it can be perceived : in this way, the proper sensibles (other than sound) are in actuality in sensible bodies—colour, for instance, in the coloured body, odour in the odoriferous body, savour in the savoury body. The case of sound is different : sound is merely in potency in the sounding body ; it is in actuality within the medium which is changed by the vibration of the sounding body ; and that is why the actuality of sound is said to belong to the medium and to hearing, but not to the sounding body." This passage is

decisive : a proper sensible has two actualities ; one actuality, as an extramental accident which is distinct from all other accidents, exists in its natural substrate ; another actuality, as a sensible form, exists within the external sense organ. There is no question at all of identifying the proper sensible with that last stage of sense-perception, the sensation.

The reason for speaking of the sensible form as *in one way* an actuality of the proper sensible is the Aristotelian commonplace, that whatever be the purpose for which any reality exists is, when realised, an actuality of that reality. The proper sensible exists in order to be perceived ; it cannot be perceived except it imprints on the external sense organ a copy of itself ; hence this impressed form (*species impressa*) may be called, in a true sense, its actuality. Moreover, the change within the sense organ reduces this latter form from potency to actuality. There is, then, in sense perception one of the applications of the doctrine that action and passion are identical with the change within the patient, are, indeed, but different ways of regarding that same change and that, consequently, the action of the agent is in the patient : "just as action [31] and passion occur in the patient as substrate, and not in the agent except as source, similarly the actuality both of the proper sensible and of the sense organ is in the sense organ as subject." Hence, the same reality is, from different points of view, called the actuality of the proper sensible and the actuality of the sense organ : the impressed sensible form is the actuality of the sense organ because it is one of those perfections that are realisable within it ; that same impressed sensible form is one of the two kinds of actuality of a proper sensible because it is an effect which the proper sensible, as agent, in conjunction of course with its substrate, can cause by transient action in a percipient. St. Thomas agrees with Aristotle in lamenting that the Greek language had not, in all instances, distinct names for these two actualities. "There are,[32] indeed, distinct names for these actualities in certain instances : for example, sonation for the actuality of the proper sensible and audition for the actuality of the sense organ. In other instances, there is only one name, namely, that of the actuality of the sense organ : thus vision is the name given to the actuality of sight but there is no name for the actuality of colour ; similarly, tasting is the actuality of the organ of taste, but there is no distinctive Greek name for the actuality of savour." St. Thomas did not supply in Latin what Aristotle did not supply in Greek : had either of them done so, we might have been spared any attempt to identify their doctrine on the proper sensibles with the kinetic theory of Democritus.

The world of matter is, for Democritus, an infinite number of atoms of different shapes which are solid and mobile. These colourless, tasteless, odourless, soundless, and (save as extended and hard) intangible realities move and jostle in the infinite void. Heat and cold, dryness and moisture and all their derivatives,

especially colours, savours, odours, sounds, exist not as distinct extramental realities but as sensations aroused by merely quantitative extramental realities in percipients. Quite other was the world of matter for St. Thomas and the Schoolmen. Neither man nor animal conferred on bodies their formal proper sensibles: the tints of the sky, the roar of the ocean, the fragrance of flowers, the savour of vegetables and fruits, the temperature of bodies, exist outside the percipient as formal accidents in their own right, distinct from all accidents of quantity and of motion. If no percipient had ever existed on our globe, the proper sensibles would not have been one whit lacking in intrinsic perfection as special accidents distinct from the quantitative accidents of matter: the skies would not be less blue, the clouds less white, the summer air less hot; the breezes would murmur through the trees, the waves resound along the shore; the grasses and flowers and fruits would in season flaunt their brilliant colours in the sun and load the disregarding air with their exquisite scents; all these wonderful perfections would exist, as such, even if our globe had never been peopled with man or animal —only, there would be neither eye, nor ear, nor nose, nor palate, nor touch, to have conscious joy in this lavish profusion of the gifts of Nature.(33)

Light and Brightness.

The Schoolmen made a distinction between *lux* and *lumen*: *lux* was the light of self-luminous bodies like the sun, *lumen* the borrowed light of bodies which owed their light to any self-luminous body. It is not easy to find suitable English words for this medieval distinction. The best I can do is to employ, in this section, light as the translation of *lux*, and brightness as the translation of *lumen*: by light, then, I mean that quality as an accident inhering in the sun as substance; and by brightness, I mean the luminous effect produced in our atmosphere by the causal action of the sun's light. And since our atmosphere was, for the School, part of that sublunary world which is totally different from the supralunary world, the medieval discussion of light involves also a discussion of that medium by means of which the light of the sun reaches our earth as brightness. There were, then, three distinct realities: light, the medium, and brightness. A good deal of unanimity (34) prevailed in reference to the nature of these three. All agreed that light was a quality of the sun, because the only alternative was the impossible one of its being the substantial form of that body: no substantial form can be an object of sense-perception; no substantial form produces accidents in other bodies; no substantial form is capable of increase or decrease. There was a similar agreement about the medium of light. This medium was called the diaphanous or transparent. The Schoolmen (35) taught, however, that the transparent is not something peculiar to air or water

or any of the bodies which are ordinarily spoken of as transparent. The transparent is a kind of universally diffused natural power, that is not capable of existing apart from bodies, and subsists in varying degrees in air and water and other bodies, particularly the heavenly ones. Transparency of the highest kind exists in the heavenly bodies: otherwise, the nearer crystalline spheres would shut off our view of the fixed stars. Transparency of lower degrees exists in terrestrial bodies: the second degree exists in fire when this element is in its natural region, for then it is most rarified; the third degree in air, and the fourth in water; the fifth degree in any terrestrial body that has a large admixture either of air or water. Now, the transparent has of itself neither brightness nor colour: when not illumined by light, it is dark, and that accounts for the darkness of the atmosphere at night; when not illumined by light, it is invisible and that is why light may be said to be in one sense the "colour" of the transparent. This use of the word "colour" is, however, not quite accurate: true colour has its intrinsic cause within the coloured object, and remains, therein, as a genuine reality whether that object be in light or in darkness, be seen or not seen; the "colour" of the transparent comes to it from the light of an external body like the sun, and disappears when the transparent is no longer under the actual influence of the sun, v.g., during the night. Now the effect of light on the transparent was brightness. As to the nature of this brightness, the Schoolmen (36) agreed that brightness could not be a body: it occupies the same place as the body which it illumines; it spreads at dawn instantaneously from east to west. Brightness must be, then, a quality of the transparent. This brightness or illumination of the transparent was necessary in order that the latter be a fit vehicle for the transmission of colour from the object to the eye: when medievals speak of air or water as the medium of colour, they speak of each of them, not as air, not as water, but as an illuminated transparency. And in opposition to Empedocles, the School taught, with Aristotle, that light does not reach our earth by local motion. Local motion would imply a time sequence, but daily experience shows that the whole horizon becomes flooded with brightness the moment the sun rises; and when opponents urged that brightness may move from point to point in the atmosphere even though we do not perceive the lapse of time occupied by this motion, the Schoolmen replied, that such a suggestion might be plausible were the interval that had to be traversed a short one, but that it is utterly unlikely because the distance between the extreme east and extreme west is so enormous.

There was practical unanimity of opinion, then, that light was a quality of the sun, that brightness was a quality of the transparent, that the medium of colour was the illuminated transparent, that light does not travel. Two further points were controverted: the relation between brightness and colour;

the nature of the quality of brightness. A number of the Schoolmen following Albertus Magnus [37] taught, in reference to the first point, that colour was not distinct from brightness but was brightness as received into the surface of opaque bodies. These held that bodies were but potentially or materially coloured, prior to the reception of brightness; that this potentiality or materiality consisted in definite blends of the constituents of opaque bodies; and, that the reception of light actualised this potentiality and introduced, thereby, the formal accident of colour. The arguments, in favour of this doctrine, were certain texts of Aristotle and such facts as the fleeting colours of the rainbow, of the tails of peacocks, of the necks of doves. St. Thomas [38] and most of the School rejected this interpretation of the Aristotelian text, and insisted on a distinction between colour and brightness: formal colours existed in bodies apart from brightness, and were of themselves visible; these formal colours cannot reach the eye, however, except the transparent medium be illuminated. Every active form, they argued, has the power of reproducing its like; some forms are so perfect as to be able to dispose the patient for the reception of their effects; other forms are not so perfect, and require the patient to be disposed for the reception of their effects by a distinct agent. Their contention was, that colour was one of these less perfect forms: it could not reproduce its like in the medium until that medium had been previously prepared by the presence of brightness. St. Thomas and the others met the facts about fleeting colours by setting up a distinction between these and permanent colours: fleeting colours do depend on brightness for the attainment of their complete formality as colours; but, as long as that brightness is present, even these fleeting colours exist as formal accidents in the object and outside the percipient. The second controversy about brightness divided Thomist and Scotist. St. Thomas [39] taught that brightness was a physical quality, differing from light only as any physical effect differs from its univocal cause. His proof consisted in pointing out the likeness between them and between their effects: brightness is an object of sense experience just as is light; brightness illumines, heats, and dries, just as does light. Scotus [40] taught that brightness was an intentional quality: a representative image dependent, both for origin and conservation, on its prototype. Cajetan with a few others advocated a combination of both views as a full solution of the facts. The Thomist view prevailed. Suarez tells us that most Schoolmen accepted St. Thomas's teaching because of the physical effects of brightness; that they rejected Scotus's teaching, mainly. because an intentional quality could never become an object of sense-perception; and that St. Thomas, himself, sometimes spoke metaphorically of brightness as an intentional quality for the simple reason that it is the most subtle of all the qualities of matter.

Gravity and Levity.

Earth was absolutely heavy, and fire absolutely light; air was heavy relatively to fire, light relatively to water or earth; water was heavy relatively to fire or air, light relatively to earth; as for the mixtures, they, whether perfect or imperfect, were heavy or light according to the predominance within them of one or other of the four elements. This medieval teaching [41] was but a transcript of the Aristotelian theory of the natural places and natural motions of the elements. Gravity was, then, a principle of downward motion, i.e. of motion towards the centre or earth: levity, a principle of upward motion or motion away from the centre or earth. The effect of gravity or levity was to cause local movement of an element towards its natural place under certain conditions: these conditions were (*a*) the presence of an element outside its natural place, (*b*) the removal of any obstacle that prevented this natural motion. The Schoolmen taught with Aristotle that gravity and levity, despite their derivation from the primary qualities, were special qualities distinct from the four primaries; also, that gravity was a special quality distinct from levity; finally, that the elements were neither heavy nor light in their natural places. They taught also that gravity and levity were accidents distinct from their substantial substrates: their reasons being, that the Eucharistic accidents retain their gravity, that the same primordial matter is found in succession in heavy or light bodies, and that the substantial form of man, the Soul, is spiritual and cannot, therefore, be either heavy or light. But in attempting to distinguish the motion due to gravity or levity from the self-motion of living beings, Thomist and Scotist fell out: Scotists [42] held that this natural motion of non-living bodies was a kind of self-motion; Thomists [43] stoutly denied this, and attributed the natural motion of non-living bodies chiefly to the generator of these bodies. In later times, this controversy lost a good deal of its intensity: Suarez suggested that the point at issue was mainly verbal; John of St. Thomas made no explicit admission, but his treatment of the issue seems to show he was of the same mind as Suarez.

Density and Rarity.

Density and rarity were, for medievalists, facts of sense-experience: solids are more dense than liquids, liquids more dense than either air or fire; moreover, the same body undergoes changes in density or rarity as is clear from the fact of its occupying, at different times, more or less space. Hence, the Aristotelian definitions: the dense body is one that has much matter in a small space; the rare body is one that has little matter in a large space. The effort of accounting for these facts led to several theories. One of these deserves to be reckoned the common view, both because of the calibre of its leading exponents

and because of the number of its adherents: the theory of Aristotle and of St. Thomas. This common (44) view implied that a non-living body, when generated, owes its actual volume to a special quality which flows from the substantial form—a quality called rarity in rarefied bodies, density in dense bodies: it implied, also, that this quality is capable of being influenced by external causes, such as heat or cold, and that, when thus affected, it may cause increase in volume apart from gain of matter, or decrease in volume apart from loss of matter. The reader, who forgets the Aristotelian denial of empty space, is apt to miss the true significance of this theory of expansion and contraction. This theory means that a cubic foot of solid matter, which is so continuously unbroken as to allow within itself no intervals of nothingness, might, apart from any loss of its own matter, shrink to a cubic inch; that this same cubic foot might, apart from any gain of matter and apart from any admission of empty space, swell out and occupy a cubic yard; that these unimaginable processes and results might be brought about by the influence of external causes on the special quality of density or rarity within the original cubic foot substance. And for the purpose of emphasising the genuine trend of this theory, St. Thomas and all its supporters distinguish explicitly between instances of real expansion or contraction due to changes of quality, and instances apparent expansion or contraction due to the intrusion into, or extrusion from, the pores of subtler matter. Three arguments are generally advanced in favour of the dominant theory. A first argument was based on the changes of volume that occur in certain changes of substance: air, when generated out of water, occupies a larger volume than did the water, and water, when generated out of air, occupies a smaller volume than did the air—and yet, in both instances, the quantity of matter perseveres unchanged; there must be, then, in these and similar instances, real rarefaction and real condensation. This first argument was confirmed by an appeal to those observable changes of volume which, apart from loss or gain of matter, sometimes occur in bodies: heat expands, cold contracts, bodies. Thirdly, these Schoolmen, denying as they did the existence of empty space, could explain the possibility of local motion only by admitting real rarefactions and real condensations: unless such processes occurred, bodies could never move from one point to another in a world that had no void; they would remain for ever in the same position crammed together like sardines in a tin. Despite these arguments the dominant theory had always its rivals. A few Schoolmen (45) admitted real expansion and real contraction, yet denied the need of this distinct quality of rarity or density. But for the supporters of the common view, the assumption of density and rarity as distinct physical qualities was essential. Density or rarity are not identical with less or greater ubication: two bodies can have equal local extension, and yet exhibit differences of density or rarity; the various

parts of Christ's Eucharistic Body have no ubication, and yet bone, blood, and flesh preserve their respective density or rarity. Hence, the dominant theory was, not merely that expansion and contraction were real, but also that they were due to sensible qualities which were perceived by the sense of touch and which produced greater or less volume in bodies.

Scotus's [46] treatment of this question emphasises three other dissentient views: and his non-committal statement of two of these three has led to his being claimed as patron of both. The third and most far-fetched theory [47] suggested that all the old quantity was destroyed, both during rarefaction and during condensation, and that a totally new quantity was generated in its stead. Scotus, as well as St. Thomas, rejected this fantastic theory: the destruction of quantity would involve that of all the other accidents, and there was no proof of such a holocaust; the destruction of all these accidents would involve the destruction of their substance, and there was not enough either of efficiency or of finality in mere changes of volume to produce this prodigious result. One [48] of the two theories, which claim Scotus as patron, is obviously allied to this extreme view, for it explains rarefaction as a generation of additional quantity and condensation as a destruction of some of the pre-existing quantity. Most of the Schoolmen held this to be inadmissible: the additional quantity generated in rarefaction must either be received into no substance or introduce double quantification—and therewith compenetration—into the already existing substance: the destruction of already existing quantity in condensation must either leave some portion of the substance without quantity, or result in the information of the whole substance by a quantity which previously informed only part of that substance. The last of these dissentient [49] views amounted to a denial of real rarefaction or real condensation: rarefaction was the intrusion into a body, condensation the extrusion from it, of subtler matter. The common view had admitted instances of apparent expansion or contraction, and explained them by the presence of pores in continuous bodies: but, as we saw, it put forward several arguments in favour of the thesis that apparent expansion or contraction did not explain all the known facts. Some of the confirmatory illustrations given by the supporters of the dominant view were not happy: interstices cannot explain the rarefaction of blood or of any human organ because the human soul can inform only a continuous substance; milk can rarefy to twice or thrice its volume—yet no one seriously professes either to observe new corpuscles in it or to compare rarefied milk to a mixture of wine and water; under appropriate conditions, eggs or chestnuts can condense or rarefy but matter, however subtle, cannot pass through the shell or the rind; some parts of the heavens are dense—for instance, the milky way—other parts are rare, but there can be no pores in heavenly bodies because æther is the most subtle matter that exists!

Artificial Form and Figure.

Artificial form and figure were put together by Aristotle and the School [50] as a special kind of quality. They differ merely accidentally: a figure is called a form, in this sense, because the shape of any artistic product is that which determines the specific nature of such products. The Schoolmen defined figure as that quality by which the extension of a substance is definitely limited in its three dimensions. No body can, however, assume different shapes apart from other qualitative changes: liquids and gases take the figure of their containing vessels; soft solids such as wax can also take on various figures; and finally, hard bodies can be broken up into parts of the most varied shapes. The Schoolmen drew, from these facts, the conclusion that figure was not identical with quantity but was a distinct accident, a sensible quality. They held, however, that figure was a quality which affected quantity directly. And from this, they concluded that, since quantity was not an active accident, figure was not an active quality. This last point seemed to them to need explanation owing to the changes wrought in bodies by the advent of fresh shapes. When a body thins or thickens, it undergoes a change of shape: but this change of shape is a secondary effect of the alteration wrought by the process of expansion or contraction. When a house receives the finishing touches of natural perfection by being walled in or covered over, it undergoes some kind of change. The School refused, however, to consider the reception of a new shape as an alteration in the technical medieval sense of a change of quality: alteration does not occur in substance when these substances are being produced, and the reception of a definite natural shape is part of the process of production of any substance. Two other points of medieval doctrine refer to this quality of figure: a natural body cannot be infinitely extended because every existing body must be definite, and the quantitative infinite has no limits; a natural body cannot be infinitely divisible because a stage of quantitative division is reached below which this body, be it element or mixture, cannot exist. Meagre and vague as is the foregoing summary, it embodies practically all that the medievals taught about figure in the non-living world. It is only when dealing with living bodies that the Schoolmen were able to make much of this special quality. Figure was regarded in the living being as a characteristic sign of species: probably, it was the importance of this quality, in tree and plant and animal, that led the medievals to interpret shape in non-living bodies as a distinct quality.

Virtual or Occult Qualities.

Medieval realism did not stop short at sensible qualities. The intellect was, for the Schoolmen, veridical: and whenever an observed effect could not be traced to the sensible qualities of

matter, they postulated the existence of unperceived and imperceptible qualities. These inferrible qualities have lived in history as the virtual or occult qualities of matter. To try to track down all qualities of this kind, that appear in medieval treatises, is useless for, although the medievalists were willing betimes to eke out the slender resources of Aristotelian physics and chemistry by appealing to these qualities, they did so only when at the end of their tether; they did all the spade-work in Cosmology with the four elements and the four primary qualities. No one can deny that the guiding principle of the Schoolmen on this topic was clear and defensible: they did but seek a distinct qualitative cause for each specifically distinct effect which they observed. But the *a priori* assumptions of Aristotelian natural science, and their own lack of instinct for spying out chances of reducing the apparently irreducible, left them in this problem of occult qualities at the mercy of every kind of fantasy. St. Thomas's (51) text warns us of pitfalls which even his sober talent could not evade. He speaks of a quality of attraction in magnets, a conclusion reasonable enough to command the assent of many moderns: he speaks of heat-producing qualities in pepper and wine, an explanation as good as any ever since proposed of the effects of pepper on the palate and of wine on the stomach; he speaks also of a blood-stopping quality in sapphires, a suggestion at which all modern readers begin to take fright; but when he speaks, in this connexion, of a quality in gold which lifts one's heart, and seriously traces that quality to the influence exerted by the heavens on the bowels of the earth, every reader becomes vividly conscious of the absurdities which lesser minds, in these ages, could read into natural facts that did not easily tally with the theories of Aristotle. Many of these occult qualities were referred to the heavenly bodies, on the plea that various effects found in sublunary bodies could not be traced either to the sensible qualities of terrestrial substances or to the motion or light of the celestial bodies. One kind of effect, which they were prone to refer to such occult causes was,—in the non-living world—the production of metals in the bowels of the earth: the four elements are less perfect than gold or silver and, therefore, cannot produce either; gold does not produce gold, silver does not produce silver; the motion and the light of the heavenly bodies cannot immediately produce these metals at such depths, for they cannot penetrate that far into the soil: neither can the motion and the light of these bodies produce such metals mediately—not by causing heat for the farther down you penetrate the colder the sub-soil, nor by causing any other known quality at these depths, for if you are asked what that quality is, you cannot say; therefore, you are driven logically to the admission of an occult quality of the heavenly bodies as the cause of these metals. Again, the pole-star attracts a magnet: it cannot do this by its light seeing that, even when that light is shut off by impenetrable clouds, the attraction

occurs ; therefore, the only solution is the admission of an occult quality. Similarly, the moon at all times affects the tides of the sea and the four humours within the human body : since these effects are caused, even when the moon is below our hemisphere, they cannot be due to its light : therefore, once more, we must admit an occult quality of the moon. Such was the general purport of this medieval plea. There is no need, then, to pursue further the discussion of these virtual or occult qualities. The reader needs only to remember that, whenever the Schoolmen speak of such qualities, they describe them and argue about them after the analogy of these qualities that were for them irrefragable : the proper sensibles. There is one virtual or occult quality, however, which refers to sublunary bodies, and has a particular interest, both because of its manner of development and because of its importance : the quality of impetus.

Impetus.

The medieval history of this quality is an interesting illustration of the desertion of Aristotle, St. Thomas, and Scotus, by most of the School.[52] St. Thomas in his Commentary on Aristotle's *Physics* follows the Stagyrite in teaching explicitly that missiles owe their free flight to motion and motion alone—a motion caused first in the surrounding air (or water) and, through this, in the missile: and he refutes painstakingly the opposing theory of the production within the missile of any motive quality or impulse. The Commentary of Scotus on Aristotle's *Physics* is lost, but his disciples attribute to him, on this topic, a view similar to that of Aristotle and of St. Thomas. Most of the disciples [53] of St. Thomas and of Scotus adopt the opposing theory, and postulate this internal quality as an explanation of the free flight of stones, spears, arrows, and cannon-balls. They are apt, however, to gloss over the fact that their leaders taught quite the contrary. Thomists sometimes deny that this theory of impulse involves a desertion of St. Thomas. They parade two texts [54] from his later writings which appear, at first sight, to countenance the need of this internal quality. An attentive reader can easily unmask the weakness of this plea. Even if these two texts did imply the theory of internal impulse, they are, in their context, the merest asides and cannot be accepted as a definite rejection of St. Thomas's explicit refutation in the *Physics :* at most, the reader would be face to face with another of those inconsistencies that occur, both in Aristotle and in St. Thomas, whenever these thinkers have not succeeded in reaching a definite solution. The truth seems to be, however, that those two texts of St. Thomas do not bear the later interpretation. This interpretation is founded mainly on the use of three words, namely, virtue, impression, impulse : but on looking up the lectures on Aristotle, the reader will find St. Thomas employing the same words in sentences where he is confessedly denying the

qualitative interpretation of such words. The Scotists are more ingenious but, not a whit more ingenuous. Their method of concealing disloyalty is to forget, for the nonce, the existence of Scotus, and to make Aristotle the scapegoat of the older view: some of these say that Aristotle's authority makes that older view probable, but that reasoning makes the later view more probable; others say bluntly that Aristotle is their friend, truth their divinity.

Setting aside these feeble evasions on the minor issue of disloyalty, the later Schoolmen make out a good case against the older theory: a gale will sweep before it feathers and leaves, the sails of ships, and the vanes of mills, but it has little, if any, effect on heavy missiles; hurricanes and tornadoes can influence the motion of many heavy missiles, but they cannot prevent these latter from being hurled in their teeth: moreover, the supposition that stones and spears, arrows and cannon-balls, are ever being borne on their paths by imperceptible hurricanes or tornadoes, which are ceaselessly renewed at their tail-ends, during their flight is utterly fantastic; finally, no air intervenes between hand and stone or spear, between powder and cannon-ball, at the instant when these missiles are being hurled into space. On grounds like these, most of the School rejected all attempts to explain the free flight of projectiles merely by the motion of successive layers of the surrounding air (or water). A motive quality, an internal accident, an impetus, was, they said, essential. Their difficulty was to locate this occult cause of the free flight. Some of them located it in these successive layers of following air: the projector impresses this qualitative impetus on the mass of air immediately behind the projectile at the moment of expulsion, and this mass, in turn, communicates a qualitative impetus to its neighbour in turn, and so on. The strength of this view was the obvious fact that, somehow or another, the surrounding air is set in motion both when the projector releases the projectile and where the projectile passes in its subsequent flight. Still, that air motion seemed much too insignificant a cause for the powerful flight of these missiles. Hence, most of the later Schoolmen held that the free flight of projectiles could never be fully explained by the forward push of travelling masses of air, and that it required, at the moment of propulsion, the production within the projectile of a motive quality—an impetus—by the projector. This occult quality was, for them, the main cause of the visible spatial motion of the projectile.

One great difficulty about this impetus was the explanation, on the presuppositions of the physics of these days, of its disappearance. The later opponents [55] of this quality urged that, once produced, it could never disappear: it cannot be destroyed by the introduction of its contrary, for it has none; it cannot be destroyed by the withdrawal of a created conserving cause, because it persists, sometimes, without a created conserving cause; finally, it cannot be destroyed by the withdrawal of the

divine concurrence, because God conserves a quality as long as that quality has no contrary. Vasquez laid this spectre by declaring that gravity or levity were sufficiently contrary to impetus to weaken and destroy it. But most of these early defenders of impetus preferred to answer that, as the impetus was intended only for the definite purpose of carrying the projectile a certain distance, the need of conserving the order of the universe leads to a subtraction of the divine concurrence, once that purpose is fulfilled: their main reason being, that, otherwise, the projectile would never stop; some of them picturing this perpetual motion as going on in the sublunary world; others picturing it as an invasion of the heavenly bodies with all sorts of possible consequences, especially, the creation of a void; finally, the question was seriously debated whether this impetus wanes gradually, or, whether it was not as strong in its own nature at the moment of God's withdrawal of His concurrence as it was at the moment of its production.

The Intensification and Remission of Material Qualities.

Material qualities increase and decrease in intensity: the gradual heating of water when put on the fire, its gradual cooling when removed from the fire, the varying brightness from sunrise to sunset and from starlight to moonlight, these, and countless other observations, left no doubt on the minds of the Schoolmen about the fact of the growth and decay of qualities. The effort to give a philosophical explanation of this intensification and this remission led, however, to much diversity of opinion. St. Thomas [56] recalls four ancient opinions: Simplicius, Plotinus, and other Platonists admitted increase or decrease of the quality itself; others, and perhaps Aristotle in the *Categories*, denied the possibility of this kind of increase or decrease, and explained intensification and remission as due to greater or lesser participation in the substance; the Stoics admitted the possibility of increase or decrease in certain habits, such as the arts, but denied it in other habits, such as the powers; a fourth group of thinkers admitted the possibility of increase or decrease in material qualities, but denied that possibility in immaterial qualities. His own view was that a quality is incapable of specific increase or decrease, but is capable of greater or less participation by its substrate: what is specific is indivisible, and, if present at all, must be present as an indivisible—for instance, heat, and whiteness, and other qualities of the same kind, are specific indivisibles of this type: but, he allows that such material qualities can be more or less intense in substances owing to their greater or less participation by these latter. Then, he reviews three contemporary explanations of what exactly is meant by this greater or less intensity: one explanation denied any essential increase in the quality, but spoke of it as more deeply rooted in its substrate—a view rejected by St. Thomas as self-contradictory;

another admitted essential increase in the quality, but spoke of this increase as due to the addition of something new—a view rejected by St. Thomas, firstly, because specific increase is impossible and, secondly, because numerical increase both involves a distinctly new substrate and puts qualitative increase on a par with quantitative increase; the third explanation accounted for intensification, not by the addition of quality to quality, but by the addition of quality to its substrate—and this view was accepted by St. Thomas. Qualitative intensification is due, he says, to the fact that the same quality in its specific indivisibility is shared more and more by the substance, and exercises more and more activity within that substance: primary qualities grow stronger, because the agent in respect to anyone of them reduces the patient from potency to actuality as well as that agent can and, because the patient in the same respect is educed more and more from potency to actuality as far as its disposition permits; secondary qualities grow stronger owing to the increasing strength, within a substance, of those primaries whence they spring.

The Thomist text in turn led to lively controversy. The Thomists,(57) rallying round the central thesis of the specific indivisibility of the material qualities, taught that qualitative intensification was due to greater participation of this quality by its substrate. They failed (58) to agree, however, as to how this greater participation was brought about: some explained it by better union with the substrate; others by a nobler kind of existence; others by the new fangled doctrine of "modes"; others by the expulsion of contrary dispositions. Durandus (59) and others took a line of their own: the growth or decrease of a quality involved for them a series of births and deaths; every new grade of quality, whether for better or worse, was generated only by the destruction of its immediate predecessor. This theory found few supporters: it was too big a paradox to assert a fire could gradually heat the water in a kettle only by destroying, at every successive advance in temperature, all previously existing heat; besides, a natural agent does not destroy but preserve and perfect its like; it was too big a paradox to assert that when a kettle of boiling water was removed from the fire, the cooling water entered on a series of holocausts of its higher temperatures; besides, if you grant a first holocaust, no adequate cause can be assigned for even its immediate successor, in this alleged succession of newly born temperatures. Scotus differed from both St. Thomas and Durandus and drew with him almost all the greater minds outside the Dominican School.(60) He explains intensification by the addition of new grades of quality, remission by the subtraction of pre-existing grades of quality: he admits, therefore, that a quality may be compounded of distinct units or grades which unify as parts of a single accident. The Scotistic line of criticism was that all the Thomistic attempts at explanation of intensification or remission were so much verbiage unless it be presupposed that, somehow or other, a

single quality may have within itself many or few units as distinct grades: no matter what you say, intensification means an increase of quality, remission a decrease of quality, and the Thomistic denial of the existence of these units or grades, as distinct, seems to destroy all intelligible explanation of the obvious presence of the more or the less in the varying strength of the material qualities. Suarez and his disciples sided with the Scotists: Suarez insisting that a certain amount of dissimilarity between those various units or grades and, in consequence, a due subordination of one to the other, was needful in order to render the Scotist theory quite satisfactory.

The Fact of Finite Activity.

Previous to the time of Albert the Great and St. Thomas, some thinkers had denied all activity to creatures: these unknown occasionalists taught that fire does not warm but God causes heat when fire is present, that a man does not move his hand but that God causes this motion whenever the man wishes it, and so on. St. Thomas [61] denounces this occasionalism as sheer folly: it destroys the systematic order of the universe, the genuine activity of bodies, and the scientific value of sense-perception. Elsewhere, he expands these points into seven arguments: our senses testify to differences of effects in nature, and these could not arise, did God alone work in all actions; the wise do not act without purpose, and if God alone is active the creature has no purpose of existence; accessories ought to accompany their principals, and, since God communicates to creatures His likeness as regards being, He must also communicate to them His likeness as regards activity; the denial to creatures of this power of producing accidents is a denial of God's power, for the communication to others of one's own perfections marks an abundance of perfection; the Sovereign Good does everything for the best, and unless each creature can actively communicate its perfections to others, this best is impossible; order is the best feature of creation, and if activity be denied to creatures, that order is destroyed; the nature of creatures can never be judged from their effects, if these creatures cannot produce effects, and, thus, this occasionalism saps the basis of all scientific investigation. This refutation of occasionalism was endorsed by Thomist, Scotist and Nominalist. Peter d'Ailly and Gabriel allowed, indeed, the probability of occasionalism, but did not adopt it; and at the end of the sixteenth century, Suarez, in summing up the history of a doctrine that never found a defender in the School, can refer only to those nameless occasionalists cited by Albert the Great and St. Thomas.

The Active Qualities of Matter.

The only accidents that could act as efficient causes, according to the School, were qualities: a doctrine, for which many subtle

arguments were evolved, but the genuine basis of which was the medieval interpretation of the facts of experience. Still, not all the qualities were active: figure, for instance, was inactive.[62] And not all the active qualities were active in the same way: some were less perfect than others in their causality. Density and rarity, for instance, produce merely changes of ubication. Gravity, and levity, and impetus, produce merely changes of local motion. The secondary qualities produce merely intentional qualities, that is, representative copies of themselves in the medium, and in the external sense-organ. Light and the four primaries are the most active of all: they produce not merely intentional qualities in sense-perception, but also physical qualities of the same kind as themselves in non-living patients. That is why, when the Schoolmen treat of the activity of material qualities, they have uppermost in their thoughts the activity of the four primary ones: the secondary qualities owe their activity, ultimately, to the primaries; light, being a quality of the heavenly bodies, was more or less ignored in discussing the changes of terrestrial bodies; density and rarity produced ubications, while gravity, levity, and impulse produced local motions—but neither ubications nor locations were, for medievalists, alterations or changes of quality, and it is characteristic of medieval thought to mean, chiefly, by the activity of a quality, its power of producing another quality either intentionally or physically. The problem of the activity of qualities is, accordingly, the problem of the activity of the four primary qualities. It is well to remember that all these four are active: the hot heats, the cold cools, the dry dries, the wet wets.[63] Aristotle had, indeed, spoken of the hot and the cold as active, and of the dry and the wet as passive; but he explains away this distinction as purely relative, and based merely on the greater or less activity exercised by these qualities in the production of substantial change; he is explicit that all four are, in a genuine sense, active qualities. And this teaching was endorsed by the School: it was, for medievalists, an obvious fact of observation.

Transeunt Causality a Making, not a Migration, of Realities.

The key-note of the medieval view of material qualitative activity, apart from the fundamental question of the divine concurrence, lies in its insistence that there is one, and only one, difference between God's creative power and the creature's efficient causality: creation implies the production of something out of nothing; finite causality implies the production of something out of a pre-existent substrate—and since this chapter deals solely with the production of accidents, we mean here, by pre-existent substrate, a substance. "There are," writes St. Thomas,[64] "two notes, characteristic of creation. The first is that nothing is presupposed, in any way, when something is

said to be created. This note marks off creation from all other changes: generation, for instance, presupposes (primordial) matter which is not generated but is made complete in generation by the actuality of the (substantial) form; and in the remaining kinds of change, a complete being is presupposed as substrate. Hence the causality, exercised by the source of generation or alteration, does not extend to everything that is present in the patient: this causality extends merely to the particular form which is educed from potency to actuality. The causality that is exercised in creation extends, however, to everything that is present in the effect: that is why creation is defined as production out of nothingness—nothing increate, if one may say so, being presupposed for the fact of creation." And in contradistinction to creation, finite transeunt causality, in reference to accidents, meant for the School the production in a pre-existing substance, as patient, by some active quality in another substance, as agent, of an accident that previously did not exist either in that patient or in any other body: gravity, levity, impetus produce *de novo* locations; rarity and density produce *de novo* ubications; the secondary qualities produce *de novo* intentional accidents in the medium and in the external sense-organ; the primary qualities produce *de novo* both intentional accidents and physical accidents in already existent substances.

This robust theory of qualitative activity is explicitly emphasised by St. Thomas in his refutation of the only opposing theories known to him: the theory of Democritus and the theory of certain Moorish Professors. Democritus tried to explain transeunt causality by the suggestion that the atoms of the agent penetrated the pores of the patient. St. Thomas repeats, against this view, the arguments urged by Aristotle: even if the alleged immigration were a fact, the resulting contact between the atoms of the agent and these of the patient would not, of itself and apart from the intervention of active principles, account for the changes wrought in the patient; moreover, this alleged migration would affect only those parts of the patient in which the immigrant atoms congregate, whereas transeunt causality affects the patient as a whole; finally, this alleged migration cannot be a fact, because did it happen transeunt causality would result obviously in a gradual decrease of size in the agent. "It is clear, then," St. Thomas concludes,(65) "that action is not brought about, as Democritus believed, by local motion, but by the fact that something real is educed from potency to actuality." And in meeting the objection, that transeunt causality does not occur because an accident cannot exist outside its natural substrate, he recurs once more (66) to this theory of Democritus. "It is not contrary to the nature of an accident to be active outside its substrate . . . unless one imagines that this (kind of activity) involves the flow of the same numerical accident from agent to patient, as Democritus seems to have believed in his explanation of activity as a migration of atoms."

This reply of St. Thomas affords a natural transition to the causal theory of these Moorish Professors. These Moors thought the only possible explanation of transeunt causality was that of a flow of accidents from agent to patient: and since they knew this flow to be an utter impossibility, they denied the possibility of transeunt causality. St. Thomas states and refutes this theory in three of his treatises.(67) "Some doctors of the Moorish Law are said to bring an argument to show that accidents are not traceable to the action of bodies, the ground of the argument being this, that an accident does not pass from subject to subject: hence, they count it an impossibility for heat to pass from a hot body to another body heated by it, but they say that all such accidents are created by God. Now, it is a ridiculous proof, to assign of a body not acting, to point to the fact that no accident passes from subject to subject. When it is stated that a hot body heats another, no one means that the same numerical heat which is in the heating body passes into the body which becomes hot; what is meant is that, by virtue of that heat which exists in the heating body, a numerically distinct heat which, until that moment was only in potency in the body about to be heated, begins to exist actually in this latter. For, a natural agent does not transfer its own form to another subject, but, reduces that subject on which it acts from potency to actuality." An equally explicit statement is found in the *De Potentia*. In the latter treatise, St. Thomas makes this tart reply. "This reasoning is utterly silly. For, when we say an accident cannot pass from one subject to another, this is to be understood of an accident which preserves its numerical identity: it does not mean that an accident, of a similar kind, may not be produced in a distinct subject by the power of one which resides in its own natural subject. The truth is that this last fact is what necessarily happens in every instance of natural action." A third criticism of this Moorish view is found in the *de Veritate*. "Rabbi Moyses says this is the view of certain exponents of the law of the Moors: for they say, that fire does not heat, but, God heats through the fire. But this is a foolish theory for it destroys natural activities in all things: moreover, it is contrary to the teachings of the philosophers and of the Saints." The teaching of St. Thomas on transeunt causality in reference to accidents is, therefore, clear and unmistakable: transeunt causality is neither a migration of atoms or a flow of accidents; it is the production *de novo* of accidents in the patient by the agent.

This Thomistic theory of transeunt causality was reproduced and defended by every member of the medieval School: Thomist, Scotist, Nominalist and Suarezian present, on this problem, a united front against Democritus and these nameless Moors; not a single text can be quoted, from any of them, in defence of either of these opposing views of transeunt causality. All the Schoolmen (68) held that the active qualities of a finite agent, apart from all transference of accidents from itself to the patient,

can set up, in this latter, a process of change which involves the passage from non-existence to existence within the patient of a totally new accident: of course, the active quality of the agent must be actually active; some active qualities are always exercising their activity, and need merely the juxtaposition of a patient in order to produce their effects; other active qualities exist normally, as regards causality, in a state of potency, and require to be previously reduced to actuality, as causes, before they can produce their effects on a juxtaposed patient. But once the active qualities of any agent are in actuality, the exercise of transeunt causality does not imply the slightest change in that agent. As a matter of fact, a subsequent change always does occur in the agent, but that change occurs only because of the reaction of the patient upon the agent: it occurs in other words only because the agent, in its turn, has become a patient (69) The only change that ever occurs in transeunt causality, as such, begins and ends in the patient; this change consists in the coming into existence of a new accident; this change is called "motion," because that was the technical medieval term for gradual transition from potency to actuality. "Motion" falls, then, wholly within the patient: and, except for the purpose of refuting Democritus and the Moors, not a single line was written in those far off days about the problem of the transference of any kind of accident from one substance to another. The attempt to explain transeunt causality as a flow of motion looms large for the first time, in post-Greek philosophy, with the advent of Descartes. The incipient convert to Cartesianism, who attempts to spy out the medieval territory of transeunt causality from the heights of Cartesianism, and, has sufficient self-control to prevent his personal feelings from leading him to misrepresent facts of history, must sum up his medieval researches on the flow-of-motion theory of causality as briefly as did the author of the famous chapter: "There are no snakes in Iceland."

The History of a Phrase.

But though the Schoolmen rejected from first to last the flow-of-motion theory of causality, they never achieved unanimity concerning the fitness of the famous Aristotelian phrase that action and passion are the same "motion." "Motion," according to Aristotle, is the gradual transition from non-existence to existence of either location or quantity or quality: this physical process, which occurs within the patient, is called action, when viewed as caused by the agent, and is called passion, when viewed as received by the patient; and this action and passion, although the same "motion," differ virtually. St. Thomas, in his Commentaries, endorses all these statements. Both masters warn their readers, however, against seeing in these technical phrases any suggestion that transeunt causality consists in the flow of the same numerical accident from agent to patient. This warning

is implicit and explicit. It is implicitly conveyed in their illustration of these phrases by the art of teaching: the professor teaches, the pupil is taught, and the resulting " motion " is the gradual enlightenment of the pupil's mind: this gradual enlightenment viewed as caused by the professor is action, viewed as assimilated by the pupil is passion. No one would dream of saying that the knowledge gained by the pupil is numerically that living knowledge, which exists in the professor's mind, and, which is exercised by him, when lecturing—in other words, of saying that every bit of information acquired by the pupil involves a loss of that information to him who imparts it, the professor: yet, that is the consequence involved in the flow-of-motion theory of causality. But if anyone is prejudiced enough to insist that this consequence, however incredible to us and to the later Schoolmen, was really at the back of the minds both of Aristotle and of St. Thomas, he may be brought to his senses by actual study of their explicit warning on this very point. A few lines farther on, when dealing with the same illustration, Aristotle writes (70): "Teaching is the actuality of the master: yet it is in another (i.e. the pupil), but it is not in this latter as *a something that has been cut off*." . . . And on these sentences, St. Thomas makes the following comment. "This (i.e. Aristotle's doctrine of the presence of the actuality of one substance in a distinct substance) would be impossible if the actuality of this one (substance) were, in that same way in which it is this substance's actuality, in another (substance)." No words could be clearer: Aristotle and St. Thomas were determined that any interpreter, who would read into their phrases about the identity of " motion " with action and passion any suggestion of a flow-of-motion causal theory, should be disavowed by themselves.

It cannot be denied, however, that the phrase, which says that action is in the patient, startles every reader. St. Thomas (71) recurs to it, again and again, giving it now one twist and now another: yet, always excluding any suggestion of the migration of an accident from the agent to the patient. And after St. Thomas's day, this verbal controversy pitted Thomist against Thomist, Scotist against Scotist, Suarezian against Suarezian. Scotus (72) defined action as the relation of the agent to the effect, and, consequently, declared action to be, not in the patient, but in the agent. His view was that, prior to the production of the effect, there was no intermediary between the agent and the effect: that is, no intermediary distinct from the pre-existing form, which is the source of action, and the newly produced form, which is the result of action. Ockham (73) and a few freelances improved on this Scotistic emasculation of the meaning of action by denying the existence of action: things of themselves come into existence just as things of themselves persevere in existence; if any intermediary be necessary between cause and effect, the extrinsic Will of God suffices—that extrinsic Will changed David

from plebeian to king, and ought to suffice, therefore, for the transition of an accident from potency to actuality; if the cause is sufficiently prepared to produce its effect, there is no necessity for action, as intermediary, between the exercise of this causality and the origin of the effect. The majority of the Schoolmen (74) rejected these solutions of Scotus and Ockham: they admitted the relationship of which the Scotists spoke, but they refused to identify it with the Aristotelian category of action, on the grounds, that this relation arose out of, and was consequent on, action; they denied the applicability of Ockham's razor to this same category, on the grounds, that a particular cause and its effect may co-exist in our world even though this latter has not been produced by the former—in proof, whereof, they urged that cause and effect exist simultaneously the moment after production, and, yet, the effect no longer depends for its existence on its causes.

But the opposition of the majority to the Scotists and to the Nominalists did not secure unity of opinion among themselves. Cajetan (75) acknowledged, as frankly as Scotus, the ambiguity of the incriminated phrase, and pointed out other texts where St. Thomas says, explicitly, that transeunt action is in the agent. He suggests that transeunt action involves three factors: the process of "motion," the reference of this "motion" to the agent as source, and a third factor, the activity of the agent, which resides in the agent and is an essential feature of all action. He interprets those Thomistic texts that proclaim action to be in the patient as referring to the first two factors of "motion," the process and the reference of that process to its source. He adds that St. Thomas does not, at any stage, exclude the third factor of activity: St. Thomas seems to ignore this third factor, in certain texts, simply because he had not separate names for each of these three factors; but, as a matter of fact, just as St. Thomas's use of the preposition "*in*," in reference to passion, emphasises the passive actualisation of the patient, similarly, his use of the preposition "*ab*," in reference to action, is a perpetual reminder for the initiated of this third factor of action, the activity of the agent. Cajetan's subtle solution of the phrase-difficulty aroused but little enthusiasm. The majority of the Dominicans stuck to the interpretation which puts transeunt action in the patient and explains away all contrary Thomistic texts as referrible only to immanent action. Of these, Capreolus gives the fullest meaning to the category of action: action and passion are physically identical with the process of "motion," and, from this point of view, are both in the same subject, the patient; but action and passion are, as formalities, opposed to each other and, from this point of view, they exist in different subjects. Action, then, has a double reference: it is produced by the agent, is, in fact, the exercise of the activity of the agent; it results in an accidental form, an actuality that resides in the patient. Action is the actuality both of the agent and of the

patient: it is the actuality of the agent, because it completes this agent by originating there; it is the actuality of the patient, because it completes the patient by enriching this latter with a process that results in a new accident. Suarez approves of the explanation given of St. Thomas by most of the Thomists: he sets out, however, to establish a modal distinction between action and its term, and ends by whittling down action proper to nothing more than a special dependence of the effect on its cause—a conclusion akin to the Scotistic theory of action as a relation. Later still, John of St. Thomas and Goudin [76] suggest a new way of reconciling the divergent texts of St. Thomas. Action implies, at least, two formalities: a formality that consists in reducing the active quality of the agent from potency to actuality, and must exist in the agent; a formality that consists in reducing the patient from potency to actuality and producing, therein, a new accident, and must exist in the patient. And in addition to these two formalities, action may be understood as referring to the relation between the effect and its cause: in this reference, action must be connected with the agent, not because of inherence, but because of denomination or emanation. Here we may close this long-drawn controversy about this phrase of Aristotle: everything that has since been written by scholastics, about the subject of the category of action, is but a ringing of the changes on one or other of these medieval views. But in finishing, it is worth insisting that all the fog, there was, about this question centred on the correct usage of a *phrase:* apart from this verbal controversy, the Schoolmen propounded a definite and intelligible theory of transeunt qualitative activity.

Contact as a Condition of Action.

The Schoolmen [77] held with Aristotle that there was no empty space in universe: all space within the crystalline spheres was filled with matter of one kind or other. This denial of the possibility of empty space did not prevent, however, the occurrence of controversy about action at a distance. St. Thomas [78] and all the Thomists, Suarez and most of his disciples, taught that transeunt qualitative activity took place under conditions of contact: direct contact, when the agent and the patient touched one another; indirect contact, when the agent and the patient did not touch but when the agent's activity affected the intervening bodies and was propagated, through them, to the patient. Ockham and the Nominalists, Scotus and many Scotists admitted [79] that transeunt activity took place, in most instances, under conditions of either direct or indirect contact: but they insisted that transeunt activity took place, in some instances, at a distance and without contact of any kind; these medievalists, also, rejected empty space, and meant by action at a distance activity between an agent and a patient that are separated by intervening bodies which are, in no way, affected by

this particular activity of the agent. For centuries, *a priori* arguments were greatly in favour with the opponents of action at a distance. Capreolus, Suarez, and others urged that the agent is actuality, the patient potency, and that potency and actuality must be somehow brought together: their opponents allowed the need of this conjunction in reference to informative actuality and its corresponding potency, but denied its need in other instances. Soto and others urged that the limitations of matter, as substance, prohibited it from influencing other substances except under the condition of contact: their opponents replied that, if the limitations of matter did not prohibit a material agent from influencing a patient two yards away through an intervening body, no reason was assignable why that limitation should prevent an agent from influencing a patient at the same distance independently of any intervening body. John of St. Thomas and others that urged the origin of the effect demanded the spatial conjunction of agent and patient: their opponents replied that this argument merely begs the question.

These replies seem to have convinced later defenders of the traditional thesis that *a priori* arguments were futile; and then, a group of Scholastics appeared who based their case against action at a distance on *a posteriori* arguments and asserted that only arguments of that kind were employed by Aristotle and St. Thomas. The strong point of these later Schoolmen was that action by contact, whether direct or indirect, was a fact of observation embodied in all our experience of natural transeunt causality. With this appeal to experience, these writers were wont to couple the following appeal to absurdity: if a finite agent can act at a distance, then, it can act at all distances, and, even, at an infinite distance; both consequences--that of absolute indeterminacy in distance and that of infinite distance—contradict the rigorous determinateness of all individual finite qualities existing in our world. Ockham, Camerarius and their followers rebutted, as best they knew how, both of these arguments. They countered the appeal to absurdity by insisting that bodies, which can act at a distance, have, in each instance, a determinate sphere of activity within which their activity is effective. They met the appeal to experience by allowing its validity, in the majority of cases, and quoting a number of cases which cannot be accounted for by contact action. This list of instances of alleged action at a distance varies from author to author and from century to century. In 1671, De Rhodes,[(80)] a convinced opponent of action at a distance, gives as objections to the traditional thesis the following list: the power of a magnet over iron at a distance; the popular account of the cause of birth marks; the malign influence on children of a witch's eye; the numbing of a fisherman's hand by the torpedo-fish; the stoppage of large ships by the sucking-fish; the bleeding of a corpse owing to the presence of its murderer; the playing of one cithara by another; the hatching power of the gaze of the ostrich; the basilisk's

killing of men by glances, and of serpents by odours ; a man's loss of voice at the sight of a wolf ; the charming of serpents by music or song ; the greater heating of the water at the top of a kettle on the fire ; the enticement of serpents from their caverns by the breath of hinds ; the toad's power of attracting reluctant weasels into its mouth by merely opening its jaws ; the sun's power of manufacturing gold, and other minerals, in the depths of the earth ; the extraction of jaundice from a sufferer's body by the stare of the wit-wall ; the frightening of dogs by the leaves of a plane tree ; the silencing of dogs by the shadow of a hyena ; the lighting of naphtha by a distant fire ; the cure of poisoning, due to the bite of the Tarantual spider, by music when enforced by the killing of the spider. De Rhodes contests, only in a few cases, these alleged facts : he denies that the ostrich hatches its eggs by gazing at them ; he denies that the death of the Tarantula helps in the cure of its victim ; and though he accepts Plutarch and Pliny and other ancient worthies as authentic witnesses to the existence and powers of the sucking-fish, he wonders why no sailor on the high seas, in recent times, has observed this extraordinary phenomenon of the stoppage of a huge vessel by a tiny fish—should such things be, he would explain them by a resisting quality that emanates from the sucking-fish. But, while admitting all the remaining objections to be facts, he denies that any of these facts can be proved to be a genuine instance of action at a distance. All these facts are due to active qualities which act both on intervening bodies and on the patients : the differences, observable between the effects produced by these qualities, on the intervening bodies, and on the patients, are due solely to the fact that these intervening bodies have dispositions which are different from those of the patients.

Unlikeness as a Condition of Action.

The agent can be like or unlike the patient in one or other of three ways : first in a specific quality, for example, heat ; secondly in the grade of that specific quality, for example, the same degree of heat ; thirdly in concomitant accidents, for example, rarity, density, figure, location, and whatever else is conducive to activity. The main question was, whether action is possible between one substance, as agent, and another, as patient, when both substances are alike in all these three ways : in other words, can an agent, with a heat quality of four degrees, act on a patient which has both similar concomitant circumstances and a similar grade of heat ? Aristotle denied that, in such instances, action was possible, and urged three main arguments [81] : the purpose of action is to produce likeness but, in this instance, likeness already exists ; the stimulus to action is the production of likeness but, in this instance, that stimulus is lacking ; the agent acts, because it is in actuality, and the patient is acted on, because it is in potency, but, in this instance, the exact likeness of these two prevents them

from fulfilling these respective roles. St. Thomas [82] and the School followed Aristotle's lead on this question: so deeply rooted did this belief of dissimilarity—in the sense explained—as an essential of transeunt action, become, in later days, that Suarez speaks of it as almost a first principle of philosophy. But when we pass from this hypothesis of complete likeness to instances of incomplete likeness, medieval unanimity breaks up. Practically all were agreed that an agent, with a quality of greater intensity, could act on a patient with a similar quality of less intensity. A few thought that an agent, with a quality of less intensity, could act on a patient with a similar quality of greater intensity: but the majority denied this for the reason that action implies victory, and, in inorganic nature, the physically weak never vanquish the strong; and when this majority was confronted with the fact that air, which from the standpoint of medieval science is less cold than water, causes water to freeze in winter, they replied that this freezing was due mostly to the influence of the cold stars. There was difference of opinion,[83] also, on the possibility of action between substances, alike both in specific quality and in grade of that quality, but, unlike in the accompanying accidents: some denied, others admitted, the possibility of action in such instances; a number suggested that, although these concomitant dissimilarities did not enter directly into the principle of activity, still, one set of them might somehow aid the active principle in their substance, and, thus, bring about as much dissimilarity in the two principles of activity as would permit action.

CHAPTER IX.

THE ARISTOTELIAN SCHOOLMEN ON THE MEANING AND CONDITIONS OF MOTION IN MATTER.

Words have their day: from age to age they wax and wane, they wither and burgeon. This wear and tear of words is vividly illustrated by the philosophical history of the term, motion: in the halcyon days of Scholasticism, motion was, for every thinker in Europe, the synonym of several distinct kinds of material change: since the time of Descartes, that ancient richness of content has dwindled away, and nowadays, outside the Scholastic School, the sole connotation of motion both in philosophy and in natural science is the meagre, if all important, one of local movement. The older meaning is essential, however, to an intelligible grasp of medieval philosophy: the shaft that is drawn to the head flies farthest. The modern scholastic will never catch up with his forbears unless his mind, in reading their writings, is ever alert to the Aristotelian technical connotation of this word; and, for lack of a similar attention, much anti-scholastic criticism is a mere tilting at windmills.

The Ambiguity of the Medieval Term, Motion.

The Schoolmen included under this all-embracing term of motion various changes which were for them, in ultimate analysis, different in kind. These differences in motion seemed to Aristotle,(1) at one stage, as manifold as the differences in being: but, on further thought, he and the School marked off four distinct varieties of motion: generation or corruption, alteration, augmentation or diminution, local motion. St. Thomas saw clearly the confusion that was bound to arise from the inclusion of these distinct kinds of change under a term that, naturally, suggests only one kind of change, namely, local motion. His apology (2) is that the human mind must start from the obvious in its invention of names: "and as local motion is naturally the first of all motions . . . we employ words that arise out of it for alteration and for every other kind of change." A fair defence of the inventor—someone will say—but surely his successors ought to have selected less ambiguous terms. The probability is that these successors, trained as they were from their youth to the peculiar Aristotelian terminology, did not feel this ambiguity as keenly as we do who are initiated, from our youth, into a wholly non-Aristotelian terminology: however that may be, the Aristotelian terminology stuck in the Schools for centuries, and must be grappled with, on

its own merits, by anyone who seeks to understand medieval philosophy. Another point (3) worth noting, here at the beginning of our study of motion, is that neither Aristotle nor the Schoolmen professed to define motion. A definition is an attempt to explain its object by something that is more simple and better known. Ultimate facts are, however, irreducible ; and as the four varieties of motion are ultimates in their own order, motion cannot be strictly defined. Hence, Aristotle and the Schoolmen are content with an accurate description of the metaphysical characteristics common to all four varieties of motion : a description that is possible only with the aid of concepts more general than those found in the categories—the concepts of potency and actuality.

The Transcendental Meaning of Potency and of Actuality.

The correlatives, potency and actuality, occur hundreds of times in the writings of Aristotle and of the Schoolmen. The former devoted, to their explanation, the twelfth chapter of the fourth book of his *Metaphysics* and all the ninth book of his *Metaphysics*. The Schoolmen, in their Aristotelian commentaries and elsewhere, are equally painstaking in their elucidation of these terms : expounding and discussing at great length every line written on this topic by Aristotle. Now, Aristotle and the Schoolmen (4) believed that the analysis of the facts of causality reveals two kinds of potency : active potency which is a force or a faculty ; passive potency which is a mere capacity for being acted on by an active potency. Each of these kinds of potency has its corresponding kind of actuality : the actuality, that corresponds to active potency, is activity ; the actuality, that corresponds to passive potency, is that complete form or perfection which its nature permits it to acquire owing to the activity of some active potency. But in the course of these researches into the mystery of causality, Aristotle analysed, as we saw, in a new and fruitful way the implications of passive potency : at the root of all passive potency, lies a reality which does not exist here and now but is coming into existence immediately, because all the active and passive presuppositions of its production are not only actually in one another's presence, but are also entering on those interactions that will result in the transition of something real from non-existence to existence. Accordingly, he and the Schoolmen called this kind of reality, potency, and, made it one of the foundation-stones of their metaphysics : potency was, for them in this fundamental sense, a transcendental, that is, a reality which cannot be subsumed under any one of the categories of being because it is equally applicable to all categories. Moreover, since physical motion is another of those realities which could not in their eyes, for a somewhat similar reason, be subsumed under any special category of being, it was this transcendental sense of potency and a corresponding transcendental sense of actuality as its

correlative that were employed in the attempt to define motion. A reality is in potency in this transcendental sense, then, when, although it does not *de facto* exist, it is a non-existent that is on the point of crossing the chasm between existence and non-existence : a not-yet-existent reality which is clearly distinct not only from what already exists, and from what can never exist, but also, from what will exist at some far distant date. Actuality in its corresponding transcendental meaning [5] is a reality of any kind that does here and now exist. "In the course of our analysis," writes Aristotle,[6] "it will also become clear, with regard to the potential, that we not only ascribe potency to that whose nature it is to move something else, or to be moved by something else, either without qualification or in some particular way, but also use the word in another sense in the pursuit of which we have discussed these previous senses. Actuality means the existence of a reality not in the way which we express by (saying it is) in potency : we say, for instance, that a statue of Hermes is potentially in the block of wood and that the half-line is potentially in the whole because each of these might be separated out ; and we even call the man who is not studying a man of science, if he be capable of studying a particular problem. Our meaning can be seen in the particular cases by induction, and we must not seek a definition of everything but be content to grasp the analogy : that as that which is building is to that which is capable of building so is the waking to the sleeping, and that which is seeing to that which has its eyes shut but has sight, and that which has been wrought up to the unwrought. Let actuality be defined by one member of this antithesis and potency by the other." "For," comments St. Thomas,[7] "prior to the chiselling of the wood, we speak of the image of Mercury as existing not actually but potentially in the block : but when the block has been chiselled, then, the image of Mercury is said to be as an actuality in the wood. The same is true of the part and the whole : a part, for instance the half, is in potency inasmuch as it is possible by dividing the whole to cut off that much from the whole : but when the division of the whole is already accomplished, that part exists in actuality. The same is true of the man who has brains and does not use them and of the man who is capable of meditating but does not meditate : but if such a one does think or does meditate—that involves the existence of an actuality." These texts are clear and pat. And in their further explanation,[8] Aristotle and St. Thomas distinguish explicitly between this transcendental meaning of potency and that mere logical possibility which implies only the absence of contradiction between the notes of any concept. Both of them, also, stress the condition that potency can be strictly predicated only of a reality that is almost immediately coming into existence : potency is an anticipation, a promise of new realities, and whenever this promise is not seriously and proximately grounded in reality, there is not potency but sheer non-being.

The Medieval Definition of Physical Motion.

Motion is a peculiar mixture of potency and actuality; it is a process by which material realities pass either from non-existence to existence or from existence to non-existence. "You must understand," writes St. Thomas,[9] "that while something may be in actuality only, and another something may be in potency only, a third something may be a mean of some kind between mere potency and complete actuality. Whatever is in potency only, is not yet in motion; whatever is already in a state of finished actuality is not in motion, its motion is over. But whatever is a mean of some kind between mere potency and finished actuality, whatever is partly in potency and partly in actuality, that reality is in motion." "The reason," writes Aristotle,[10] "why motion seems incapable of definition is that it cannot be reduced either to mere potency or to finished actuality. . . . Motion seems to be an actuality but it is an imperfect kind of actuality because it is the actuality of a being in potency. . . ." The same authority has left us four descriptions of motion [11]: motion is the actuality of potential being as such; motion is the actuality of the movable as such; motion is the actuality of the active and passive as such; motion is the actuality of a being in potency in so far as this being is in potency. "Accordingly," comments St. Thomas,[12] "any unfinished actuality has the (two) characteristics of motion: the first, because it is in potency in reference to further actuality; the second, because it is an actuality in reference to whatever is less finished than itself. Motion, then, is neither the potency of what exists potentially nor the actuality of what exists actually but the actuality of what exists in potency: the word, actuality, pointing out its relation to the previous potency; and the word, potency, pointing out its relation to the subsequent actuality. Hence, Aristotle's definition of motion as the actuality of the potential as such, is excellent." St. Thomas proceeds to illustrate these abstractions by the familiar process of heating water on a fire: before the water is brought near the fire, it is merely hot in potency and it is not yet in heat-motion; when the heating has been carried to boiling point, the heat-motion is over and the finished actuality of heat exists in the water; but, in the interval that elapses between the time that the kettle is put on the fire and that the water is fully boiled, the water is gaining heat little by little, and it is this gradual acquisition of heat from start to finish which constitutes heat-motion. That gradual acquisition of heat is motion because, at every stage of it, an unfinished heat-actuality exists; every stage of the heating is an actuality because some heat is present; every stage of the heating is an unfinished actuality because more heat is being continually produced. No particular degree of heat before or during the process of heating is motion, simply because it is such and such a degree of heat: the degree of heat which the water had, before coming under the

influence of the fire, is not part of the heat-motion, it is simply a starting-point of motion and, as such, a complete actuality, not part of the making of an actuality; each degree of heat gained during the boiling is a heat-motion *only* because it is an actuality in the making which tends to pass beyond itself into a further actuality; were any degree of heat to cease to pass beyond itself, because, for instance, the kettle was removed from the fire at some particular moment before the water was fully boiled, that degree would be a finished state of heat and not a motion of heat; similarly, if, after some time away from the fire, the kettle were put back and thereby the heating begun again, that particular grade of heat, from which *ex hypothesi* the heating starts afresh, would not be part of the subsequent heat-motion but would be its starting point. Heat-motion—and the same is true of every other motion—exists only as long as any grade of heat is being produced and is passing, unbrokenly, into another grade. This illustration puts flesh and bones on the bloodless abstractions of potency and actuality as descriptions of motion: of course, it must be interpreted in the light of the medieval theory of heat as a qualitative accident distinct from local motion and from quantity. Motion, then, was the name given by the Schoolmen to every continuous process in matter which tends to pass beyond itself into something else: this process has a starting point whence motion begins and a finishing point where motion ends; there is no motion at the starting-point, there is no motion at the finishing point, all the motion lies in the unbroken process that links the one with the other.

The Motion of Generation or Corruption.

All the Schoolmen agreed (13) that physical motion, in the strict sense, was verified only in those gradual changes of quantity or quality or location that occur in substances. They held, also, that strict physical motion implied certain conditions. It is a process between extremes that are contrary: one positive term is lost and another gained. It is successive: the transition from one extreme to the other is effected by traversing the intervening phases. It is continuous and unbroken in its succession: a few Schoolmen denied the need of this continuity in local motion, and a large number denied its need in alteration, augmentation, diminution; but, the majority affirmed its need in all three kinds of physical motion on the grounds that any interruption of motion was rest.

But motion had been used, also, by Aristotle, in a wide sense, and from this point of view, a controversy arose as to whether generation and corruption could be set down as forms of motion. Aristotle seems to have held that they could, for he cites generation and corruption and local motion as examples at the close of his definition. St. Thomas (14) and most of the Schoolmen agreed with him. Soto and others urged, against this view, that genera-

tion and corruption are not actualities of potential being as such because their occurrence takes place instantaneously, and does not leave the subject of these changes in potency towards any subsequent actuality. Their opponents replied that even in generation and corruption the process of change can be distinguished from its result, namely, the gain or loss of a substantial or accidental form: and that prior to this change the subject is in potency to two actualities, the unfinished one of change and the finished one of the end-state; and that, therefore, even in generation or corruption there exists an actuality which is incomplete and tends to something further. This reply covers both kinds of generation or corruption: the gain or loss of atmospheric brightness, the gain or loss of the substantial forms of the elements. Some Schoolmen added a special plea for substantial generation or corruption on the grounds that, even if it were not of itself continuous and successive, it presupposes alteration and falls on that account within the Aristotelian definition of motion.

The Motion of Augmentation or Diminution.

The motion of augmentation or diminution never occurs in those bodies to which we have limited the scope of Cosmology: non-living bodies. By motion of augmentation or diminution, the Schoolmen (15) meant only that growth or decline in size which results in living bodies as a consequence of the balance they maintain between the intake of food and the output of work. Normal human development was the common example of this kind of motion: up to the age of twenty or twenty-five, the human body is, medievalists believed, gradually increasing in size; from twenty-five to about thirty-five, it is merely holding its own in size; from thirty-five onwards, it is gradually shrinking in size. Good nutrition is the basis of growth: when food is absorbed by a thriving organism, all the organs increase in size. Malnutrition, whatever be its cause, is the basis of shrinkage: when the food absorbed is less than the amount of wastage, all the organs decrease in size. These facts of living growth and of living decline include all that the medievals meant by motion in quantity. They steadily refused to reckon as motion in quantity any of the increases or decreases in size which occur in non-living bodies. Not that they were particularly consistent in their usage of words: "augmentation" is often used for all sorts of increase in size in non-living bodies; increase either in extension or in intensity; increase in quantity whether continuous or discrete; increase in bulk either owing to rarefaction or owing to the juxtaposition of new parts. Still, when treating explicitly of motion in quantity as one of the kinds of physical motion, they emphatically lay down that this kind of motion is verified only in the growth and decline of living bodies. And, at the same time, they insisted with equal emphasis that all apparently similar happenings in non-living bodies were totally distinct in nature: that these

non-living increases in size, sometimes, did not involve an addition of quantity ; that even when non-living increases in size do involve an addition of quantity, this addition is sometimes an addition of discrete quantity ; that even when these non-living increases in size involves an addition of continuous quantity, this addition is the mere resultant of local motion.

The Motion of Alteration.

Alteration is another medieval word with many meanings : in its widest sense, it implies simply a difference of accidents and was used to signify any kind of accidental change—whether of quality or quantity or location ; in a less wide sense, it was restricted to those changes that are changes of quality. But even this restricted meaning is not the technical meaning of this word as one of distinct kinds of physical motion. There are changes of quality which do not imply the loss of a preceding quality, either because the incoming quality has no contraries or because the incoming quality is the natural sequel of quantitative change : atmospheric brightness is an example of the former, shape an example of the latter change. Now, both Aristotle [16] and Schoolmen excluded these changes of quality from alteration in the strict sense. For them, alteration or motion in quality occurs only when a body loses one sensible quality and gains another by gradual transition through all the intervening phases which separate these two contraries : the cooling of hot water and the heating of cold water are the favourite illustrations. They distinguished three sub-varieties of this alteration : ordinary alteration whereby a body gains some sensible quality which it previously lacked ; intensification whereby a quality already existing in a body becomes more intense ; remission whereby a quality already existing in a body becomes more feeble. They were careful, also, to point out that alteration, as a distinct kind of physical motion, refers primarily and directly to the sensible qualities of matter—those qualities that come third in Aristotle's fourfold division of the category of quality : qualities of the first and fourth division either do not imply the loss of a contrary quality or arise as natural resultants of some other change : some qualities of the second division, power and powerlessness, have no contraries and are properties which originate by dimanation ; other qualities of the second division, the rough and the smooth, the hard and the soft, etc., are at times properties which originate by dimanation, but at other times they are present as adventitious accidents and, then, they fall under the third division and exemplify motion in quality.

Local Motion.

Local motion consists in successive and unbroken transition from one point in space to another : this implies, first, that the

position in space of the moving body is, at each successive instant, immediately outside but still in contact with the position occupied the instant before; it implies, moreover, that each position between the starting point and the finishing point is incomplete in itself and tends to pass beyond itself into its successor. The analysis of the ever recurring and apparently simple fact has been the torment of philosophers of all ages. It is little wonder, then, that, on the crude presuppositions of Aristotelian physics, the problem arising out of local motion played havoc with the solid phalanx of medievalism. Two controversies concerning local motion have already been discussed: Thomist was pitted against Scotist on the explanation of the natural motion of the elements; Thomist and Scotist deserted Aristotle, St. Thomas, and Scotus, on the explanation of the free flight of projectiles. An even more bewildering variety of opinion prevailed as to what exactly happens or does not happen in local movement, apart from the question of the efficient cause of that motion.

Nine different theories were advocated about the middle of the seventeenth century.(17) The pith of this problem lay in the theory of ubication: local motion is confessedly an unbroken series of locations; and location was commonly said to be due to ubication. But what is ubication? Aristotle, St. Thomas, Scotus and many Schoolmen seemed to have explained ubication as some sort of extrinsic relation.(18) Even thus early, there was little agreement concerning the source of this extrinsic relation: some held ubication to be the result of a divine decree; others, the result of the agency that produced the located body; others, the result of the nearest surrounding bodies; and so on. This earlier theory of ubication continued to find defenders at all times, but most of the later Schoolmen rejected it, and taught that ubication was something intrinsic added to the body for the purpose of keeping it in this rather than that location. Molina (19) is credited with being one of the first advocates of this later view: Suarez became its patron; and his teaching seems to have been accepted not only by most of his brethren but also by the later Dominicans. The main concern of Suarez and his successors is the nature and the number of these intrinsic ubications. Was this intrinsic ubication a mode or an accident? Most of them taught it was a mode, but a minority insisted that it was an accident. Was there in each body one or more of these intrinsic ubications? A minority taught that one intrinsic ubication sufficed for each distinct location of a whole body: some of these putting that ubication in the substance, others putting it in the quantity. Others—and they seem to have been at one time in a majority—taught that a distinct ubication was needed for each distinct reality in the body, that is, for each of the substantial constituents, for each of the distinct accidents, for each of the intrinsic modes, in short, for every distinct reality in the body, except the ubications themselves; and some of these writers gravely explain this exception on the grounds that if the

ubications themselves needed other distinct ubications, the result would be an infinite regress of entities. The root-cause of this amazing development has been already treated in another reference, but is worth repeating briefly here. Those who maintained that ubication is either an intrinsic mode or an intrinsic accident did so on the plea that location is not a nothing: it is not the same thing to be in Dublin as to be in Cork, it is not the same thing to be fixed at one position in space as to be traversing successively and continuously several positions in space; therefore, location implies in each located reality—substance and accident and mode or all three combined—an internal something, whether accident or mode. Those who denied that ubication is either an intrinsic mode or an intrinsic accident did so on the plea that entities are not to be needlessly invented: it is not the same thing to be in Dublin as to be in Cork, it is not the same thing to be fixed at one position in space as to be traversing successively and continuously several positions in space, but, the difference lies solely in the extrinsic relationships of the located body; immediate contact, whether permanent or fleeting, with different surroundings is something real, just as being clothed is something real; and as clothes add nothing intrinsic to the person covered by them, so location adds nothing to the located body.

It is obvious that the adoption of one or other of these theories of ubication involved important consequences for the concept of what, apart from efficient causality, is meant by local motion. All the Schoolmen admitted that local motion was an unbroken and successive series of locations: consequently, what was for Aristotle, St. Thomas, and Scotus, an unbroken series of extrinsic relations that added nothing internal to the moving body, became for Molina and his successors an unbroken series of generations and destructions of either intrinsic modes or intrinsic accidents; a series of generations and destructions of single successive modes or accidents for those who held that one intrinsic ubication sufficed for each location of the whole body; a series of generation and destruction of several simultaneous modes or accidents for those who postulated distinct ubications for every distinct reality in the moving body. Even this last appalling birth-rate and death-rate during local motion does not seem to have satisfied everyone. A modern [20] scholastic suggests a subtle extension of this doctrine of intrinsic ubication which I have been unable to track to its medieval source. It appears that some author, by reflecting on these intrinsic ubications, convinced himself that, useful and necessary as they are, they were after all only formal causes of location. What, then, is the formal cause of motion? Impulse or impressed force? No, it is an efficient cause which, at most, starts and keeps up the motion. Accordingly this Schoolman invented other entities, distinct both from impulse and from intrinsic ubications, that function as formal causes of local motion.

Another interesting point in reference to the medieval account

of local motion is the nature of the superiority claimed for it, over quantitative and qualitative motion, by the Schoolmen. "Local motion [21] is superior to other kinds of motion from the point of view of time because it alone can be eternal . . . it is also superior to them in nature because it is a necessary preliminary of all of them : growth is impossible unless preceded by an alteration by which what is unlike is changed and made like ; and in its turn, alteration is impossible without previous local motion because alteration begins only when that which causes change of quality in another is nearer to that other than it hitherto was. It is also superior in perfection to these other kinds of motion, because local motion does not cause any intrinsic change in the moving body but merely changes this body in an extrinsic way ; and that is why it may be present in a body already perfect." So far St. Thomas : the only difficult allusion in his text being a " body already perfect " : by that, he meant simply the incorruptible heavenly bodies. This teaching of St. Thomas about the superiority of local motion was accepted by all the Schoolmen : of course, those Schoolmen who interpreted ubication as an internal mode or accident did not admit that local motion implied no intrinsic change. These supported this thesis of St. Thomas, however, on the grounds that local motion caused much less change within a body than did growth, diminution, alteration, generation, corruption.

The Distinction between the Mover and the Moved.

The principle on which Aristotle and St. Thomas based this distinction is familiar, in its Latin dress, to every student of Scholasticism : *quidquid movetur, movetur ab alio.* The ordinary English translation—whatever is in motion is moved by something else—lends itself to two misconceptions. Minds that are familiar with no physics except the physics of Newton are apt to interpret this medieval principle as referring merely to the need of an initial push or stir. That is not so. The genuine medieval sense of the principle is that motion, of its very nature, needs not only starting but also continual keeping up by some continually acting cause ; hence the better translation is—whatever is in motion is put in motion and kept in motion by something else. A second common misconception is that the suggested distinction between mover and moved must be always a distinction between supposit and supposit. Neither is that so. Aristotle [22] has two formulations of this principle : everything in motion must be put and kept in motion by something ; everything in local motion is moved either by itself or by another. And both he and the Schoolmen taught that things which had souls were moved by themselves, but in these instances they insisted that one part of the substance was the mover and that another part of it was the moved. St. Thomas [23] and his disciples admitted no exceptions to this law of physical motion : Scotus and his disciples did

admit exceptions. The Scotists [24] carefully stressed the point of their objection: they allowed that bodies are immediately influenced by God in their motions and, in this sense, did not impugn the principle; they allowed, also, that bodies are extrinsically stimulated to motion by their surroundings and, in this sense, they did not impugn the principle. What they did maintain was that, presupposing the divine concurrence, some bodies act as total secondary causes: that is, that these bodies act independently of the effective, immediate concurrence of any other secondary causes in the production of their effects; and that, therefore, such bodies move themselves. The controversy ranged over all kinds of motions, psychical and physical, vital and non-vital. I shall avoid altogether the question of psychical motions and shall refer to vital motions, only as far as is necessary to illustrate the points at issue concerning physical motion.

The first argument in favour of the universality of the principle was based on the nature of physical motion. Physical motion is the transition from non-existence to existence of some reality out of some substrate. This transition is sometimes instantaneous: generation of substance consists in the instantaneous emergence of a substantial form from primordial matter; similarly, the generation of an accident like brightness is instantaneous. But, as we have already remarked, these instantaneous births of realities were included under the concept of motion, only by majority vote and, even then, with subtle explanations. Strict physical motion is a gradual transition from non-existence to existence, and was verified only in augmentation or diminution, alteration, and local motion. Now it is obvious, the Thomists argued, that any of these kinds of motion can happen only in a substrate which is previously lacking in that particular reality that is its goal of the motion: primordial matter cannot undergo the process of acquiring a substantial form which it already possesses; a substance cannot undergo the process of acquiring either a quantity or a quality or a location which it already possesses; in technical language, no being can be reduced from potency to actuality in any reference except it was previously in potency in that reference. But whatever is lacking in any particular reality cannot, out of its own unaided resources, enter on the process of supplying itself with that reality: no being can give itself what it has not got to give. Therefore, whenever a being or part of a being that lacks any reality undergoes the process, be it instantaneous or gradual, of acquiring that reality, it must during that process be drawing on resources external to itself: in other words, whatever is in motion is put and kept in motion by something else; otherwise, the reality that is acquired by the process of motion would have no cause. "The mover," says St. Thomas,[25] "works change continually until the body moved attains the term of its motion": if it did not, the motion, either in whole or in part, would be a beginning without a cause. To deny this principle of motion, then, is to deny the principle of

causality. St. Thomas goes on to show that a denial of the principle of motion involves a denial of the principle of contradiction. It follows from the argument already given that the new reality acquired by motion must come from a source distinct from the substrate which is in motion towards that reality. St. Thomas draws from this the obvious inference, that the cause of motion must possess in some way that reality which it produces in the patient: no being can be reduced from potency to actuality except by some being that is already in actuality; fire which has the actuality of heat moves wood, by making it pass from the potency to the actuality of heat. This actuality may exist in one or other of two ways in the cause of motion: formally, when it exists in the cause of motion in a manner similar to its subsequent existence as an effect in the patient, and this occurs in all instances of univocal causality; eminently, when it exists in the cause of motion in a higher and better way than it exists subsequently as effect in the patient, and this occurs in all instances of equivocal causality. But whatever be this manner of pre-existence of the actuality in the cause of motion, that pre-existence marks off the cause of motion from the patient: the agent has this actuality, the patient has merely the potency of that actuality. Now, the same being or part of a being cannot be simultaneously in potency and in actuality with reference to the same perfection: the principle of contradiction affirms that the same reality cannot be simultaneously hot and not-hot, white and not-white. Therefore, to deny the principle of motion is to deny the principle of contradiction.

The second argument in favour of the universality of this principle was based on induction. From the point of view of origin, motion was distinguished by the School as three-fold: incidental, violent, natural. Incidental motion occurs in any reality, simply because that reality is affected concomitantly by the motion of another reality: a rider is incidentally moved when his horse moves; whiteness is incidentally moved when a white body moves; a man's hand is incidentally moved when someone shakes it; a musician is incidentally moved, as being healed, when the convalescent is a musician; and so on. Violent motion occurs when a body is moved by an external cause after a fashion in which it, as recipient, cannot co-operate: this motion is not identical, then, with every kind of motion produced by an external cause; it is verified only in motions that are contrary to, or stronger than, the natural powers of their recipient. These violent motions occur in quantity, in quality, in location: violent quantitative motions are exemplified by premature puberty due to overfeeding or by abnormal size in grain due to unseasonable rains; violent qualitative motions are exemplified by fevers that reach their various crises on other than the generally accepted critical days, or by those qualitative changes that immediately precede change of substance; violent local motions are exemplified by the hurling upwards of stones, the hurling downwards of

fire, and by the free flight through the air of heavy projectiles. Natural motion is that which proceeds from any internal principle of a body in accordance with its specific nature: all those motions that are neither incidental nor violent are natural; but these motions are usually exemplified by the vital motions of living beings, and by the local motions of the four elements to their proper places. These being the presuppositions of the Thomists, they had no difficulty about this inductive proof as regards motion that was either incidental or violent: in all such instances, whatever was in motion was put and kept in motion by something else. They were also confident about the verification of the law in all vital motions: their general thesis being that vital motions are caused by the soul in faculties which are distinct from itself—locomotive, vegetative, sentient. The natural local motions of the elements seem to have been their greatest difficulty. An easy way-out would have been to hold that gravity and levity are the principal causes of these motions: accidental qualities resident in the elements and distinct from the locations they produce, somewhat after the analogy of the impulse of the later Schoolmen. But St. Thomas and the earlier Schoolmen reject that kind of solution for several reasons: it would imply that the elements are living; that the elements could stop themselves at any stage of their natural motion—a supposition contrary to all experience; that a self-moving being might have only one direction in its motion—an unreasonable supposition, for if the self-mover can move upwards, why cannot it move downwards?; that the elements had a collection of parts like the limbs of an animal—an irrealisable supposition in a homogeneous continuum. Consequently, these writers insist that the natural motions of the elements is due to two external causes: the generating cause which gave them a nature that seeks a particular place in the universe, and gave them, for that purpose, gravity and levity as instrumental causes of motion; the external cause that, at the moment preceding their motion, removed any external obstacles which prevented them from seeking their natural places. And thus, even the natural motions of the elements verify the general principle of motion.

Scotus and his disciples challenged both of the Thomistic arguments. They granted the impossibility of formal potency and formal actuality in regard to the same perfection at the same time. They urged, however, that formal potency and virtual actuality were simultaneously compatible, and that a being in this state could move itself: such a being can be a cause of motion for it has the power of producing perfection; such a being can be a recipient of motion for it has the capacity of acquiring perfection. Thomists retorted that, since virtual actuality implied the power of producing a perfection, the being which possessed it could not be lacking in that perfection: and that, consequently, the alleged simultaneous compatibility of formal potency and virtual actuality was impossible. Scotists

met this retort by a distinction. Virtual actuality may mean the presence of a perfection in a higher and better way than is implied by its formal presence: thus, the sun possesses heat virtually, and not formally as fire possesses it; and when virtual actuality means presence of a perfection in this higher way, it is contradictory to speak of the possibility of self-motion towards a formal actuality of the same kind. Formal heat would be of no use to the sun except to produce heat in other bodies, but the sun can do that apart from formal heat: hence, the sun would not be made more perfect by the formal actuality of heat; on the contrary, the formal possession of heat by the sun would be an imperfection for two reasons—this formal heat would be a superfluity, and would involve corruptibility or some other imperfection in that heavenly body. There is, however, another and totally distinct meaning for virtual actuality. A perfection may exist in virtual actuality in a body in the sense that this body, although it can produce this perfection, cannot accomplish without that perfection what it can accomplish by means of its formal possession. Now, to contain a perfection in this kind of virtual actuality is obviously not to contain it more perfectly than is implied by formal actuality. Therefore, it would not be contradictory to assert of any being the simultaneous presence in it of this second kind of virtual actuality and of formal potency in regard to a perfection. And this is the only kind of virtual actuality, Scotists contended, that we claim for those bodies that are self-moving. Thomists rebutted this argument by pointing out that the power of producing a perfection is something distinct both from the exercise of that power and from the perfection afterwards produced by that power: hence, the increment of reality which separates the virtual possession of any perfection from the later formal possession of the same perfection is certainly not in the virtual actuality; now, no being can give itself that by which its own sum of reality is enriched; further, the transition from virtual to formal actuality is not, according to the Scotists, aided from outside; therefore this transition must be, on their hypothesis, an event without a cause, a causeless beginning of being. The Thomists added that Aristotle was able to prove the existence of a motionless Prime Mover only because he insisted on their interpretation of this principle of motion. Scotists replied that the existence of a motionless Prime Mover can be proved from the fact that no secondary cause can move itself independently of two factors extrinsic to itself: the stimulation of other secondary causes as a condition determining action here rather than there, now rather than then; the immediate concurrence of God as a concomitant higher cause. But neither of these extrinsic factors contradicts, they asserted, the thesis of self-motion as defended by Scotists. And they added that Aristotle proved the existence of a motionless Prime Mover, not by showing that self-motion was an utter impossibility, but by pointing out that even self-moving beings owe their powers of

self-motion to their respective generating causes and, thus, compel us ultimately to admit a motionless Prime Mover: a Being who does not depend on anything outside Himself for His perfections, and who is the ultimate source of every perfection that is found in all extrinsically conditioned beings.

The Scotists urged against the second Thomistic argument, that based on induction, a number of typical medieval facts: the local motion of the elements to their proper places; certain qualitative motions involved in the restoration of bodies to their natural state after violent alteration; the heating of slaked lime and of pressed grapes; the greater heat, in winter, of the stomach and of well-water. The brunt of the controversy was borne by the first pair of alleged facts. Scotists argued that no secondary causes of such motions can be assigned except the bodies in which these motions occur. The only other available secondary causes in the circumstances are those that remove the obstacles to motion: the cause that removes whatever prevents a stone from falling or a fire from ascending; the cause that removes whatever prevents hot water when taken off the fire from recovering the natural coldness of water. Now, no one dreams of explaining the motions in question by these latter causes: they are obviously incidental; their destruction does not put an end to the motions. Nor can it be maintained, for instance, that the recovery of its natural coldness by water is due to the presence of some residual coldness in the water at the moment it is taken off the fire: sometimes, there is apparently none of this residual coldness; at any time, there is not sufficient residual coldness to account for all the coldness subsequently produced; moreover, other bodies, that are capable indeed of being made cold but do not postulate connaturally the coldness of water, never develop, when removed from the influence of heat, that degree of cold which is characteristic of water. Therefore, there is no explanation of any of these facts except the admission of self-motion in those bodies within which these motions occur. Thomists met the objection from the natural motion of the elements by assigning those motions to the generator of these elements as a principal cause, and to gravity and levity as its instrumental causes: for the reasons already given in the explanation of their inductive argument. And those Thomists who admitted impetus as qualitative cause of the free flight of projectiles pointed out that this qualitative cause, being but an accident borrowed for an emergency and not a true property, did not involve vitality in non-living bodies: but that gravity and levity, if admitted as principal causes of natural motion, would imply vital motion in the elements. Thomists, also, answered that the alleged instances of restoration are due to the generating causes of the water or other substance, in which this restoration occur. They concluded, then, that neither of these objections affect the universality of the principle of motion. The force of these Thomist replies is bound up with that theory of theirs which refuses to see in

resultance an instance of efficient causality. The dimanation of properties is a natural resultance of the generation of a specific essence, and the only efficient cause in question is that which generates the specific essence. As for the heating of slaked lime and of pressed grapes, Thomists were wont to account for the former by the presence in lime of latent fiery particles, and for the latter by the presence in grapes of spirituous parts. They explained the alleged higher temperature, in winter, of the stomach by the suggestion that winter cold closes the pores of the skin and prevents the vital spirits from leaving the body: and they explained the alleged higher temperature of well-water by the suggestion that, in winter, the subterranean fiery spirits of the bowels of the earth cannot escape through the pores of the earths' crust, and are concentrated in wells.

After centuries of controversy on this question between Thomism and Scotism, Suarez [26] went over the whole ground again and wound up his survey by compromise: a compromise accepted by most of his disciples. He sided with the Thomists in reference to the motions of non-living bodies; he sided with them, also, in reference to alteration and growth in living bodies. He sided with the Scotists in reference to the alleged compatibility of formal potency and virtual actuality. He sided with the Scotists, also, in reference to the local motion of living beings: and it is for the purpose of illustrating this application of the law, that I follow at some length here the exposition of Suarez. He remarks pertinently that you cannot go on talking for ever of one part moving another within an animal. You must stop somewhere at a part which apparently moves itself. The usual reply is that the soul is the continually acting cause of this local motion, that it puts and keeps in motion the muscles, and through them the limbs. Suarez admits the *probability* of this reply but urges its difficulty in reference to animals for a consistent hylemorphist. He draws attention to those texts in St. Thomas that speak of the heart as the source of this local motion: the nerves and vital spirits seem to be under the control of the heart—at any rate under control either of it or of the brain. Hence, the real issue centres on the motion of either of these: and in conformity with the earlier view, Suarez discusses this issue from the standpoint of the heart as the source of living local motion. Heart-beats, owing to the alternation of expansion and contraction were a tremendous puzzle to the Schoolmen: some held that the heart was put and kept in motion by an external being—a solution scouted by St. Thomas as irreconcilable with vital action; others suggested that the heart was put and kept in motion by innate heat—a solution rejected as implying heat to be an immediate cause of local motion; others suggested that one part of the heart puts and keeps in motion the other parts—a solution set aside as pushing back and not solving the problem; others—among them St. Thomas—suggested that the heart is moved by the soul as natural form of the body, but that this

motion of the heart must be attributed to the generating cause since it results, as a property, from the soul as form. Suarez objects to this solution of St. Thomas, mainly, for the reason that it puts the motion of the heart on the same plane as non-living motions: he adds that if you attribute the pulsations of the heart to the generating cause, you are logically bound to attribute to the same cause the motions of respiration and nutrition. He concludes, accordingly, that somehow or other the whole heart moves itself. "Hence,(27) I see no difficulty in attributing this motion to the animal itself, and in saying that an animal, in reference to the same integral part, may be mover, and moved; and that, it is sufficient (in motion which is vital and partial) to have a distinction merely between the aspects of acting and of being acted on; for it is only when speaking of the motion of an animal as a whole, that Aristotle talks of the motion of one part being brought about by another part." John of St. Thomas, in reaffirming at a later date the Thomistic view, grants that the motion of the heart, since it is vital, cannot be readily attributed to the generating cause. "Still, since (28) even life in creatures is received and derived from another, the living creature in that first motion with which its life begins does not move itself in a sense that excludes being moved by another: as St. Thomas teaches (I, q. 13, a. 3, also I, q. 105, a. 4, ad 2). Hence the vitality of that (first) motion consists in a beginning of life that is received from another, but that (first) motion is not the completion and perfection of life. For, this latter is the activity of the living being which moves itself inasmuch as it causes motion in some parts by means of one part that has been already moved and actualised: that is why the motion of the heart has as its goal not quiescence in any particular form, but existence as an actuality for the motion of other parts (of the body); and this, its peculiar make, must come from the generating cause for it is the first motion. There is, as St. Thomas teaches, in the thirty-fifth *Opuscule*, a likeness in this way between the motion of the heart and the motion of the heavens: for the heaven is moved not with a view to quiescence in any particular form, but with a view to its duty as mover and first alterative of other bodies." Goudin,(29) also a post-Suarezian Thomist, puts the same point more briefly. "I reply that the motion of the heart is from the generator as cause. For, as St. Thomas lays down, *Op.* 35, the motion of the heart follows the form of the heart since it is a property of this latter: hence, this motion comes from the cause by which the heart is produced: for that which gives being gives also the (necessary) consequences of being."

Physical Terrestrial Motion and the Heavenly Bodies.

The material heaven of the Schoolmen was, in essentials, that of Aristotle. They were not quite so confident, as he was, of these subsidiary hypotheses which Eudoxus and Calippus and he

had invented to explain away the apparent deviation from perfect circular motion of the planets: as we have seen, Ptolemy's theory of epicycles and eccentrics was dominant in medieval astronomy. But this hesitancy, about the exact manner in which certain anomalous appearances in the movements of the planets were to be accounted, for did not prevent the Schoolmen [30] from accepting as absolutely certain the fundamental doctrines of pre-Copernican astronomy: the existence of solid crystal spheres as bearers of the stars and planets; the perfect circular motion of each of these crystal spheres; the linkage of each lower sphere to its immediate outer sphere, and its consequent participation in the motion of all outer spheres. When introducing this theory into their metaphysics, they attended mainly to the principal spheres. Aristotle had spoken of eight principal spheres and had called the outermost one, that which bore the fixed stars, the first moved. Later discoveries added to this Aristotelian number. Hipparchus (*c.* 155 B.C.) discovered that the sun no longer crossed the equator at the first point of *Aries*, but some little way back westwards in the constellation, *Pisces:* and as the eighth heaven could not be subject to two simultaneous revolutions in contrary directions and in different planes, another principal sphere, distinct from and outside the eighth, was postulated for this precession of the equinoxes. Alphonso X of Castile, a contemporary of St. Thomas, discovered in the firmament a new motion which was called trepidation, because it caused an inclination now to one pole and now to the opposite pole: and for the reason given above, a third principal sphere, distinct from and outside the eighth, was postulated for this alleged phenomenon, Accordingly, the Schoolmen admitted ten principal star-bearing crystal spheres: one each—in order—for the Moon, Mercury, Venus, Mars, Sun, Jupiter, Saturn; an eighth outside these for the fixed stars; a ninth outside the eighth to account for trepidation; a tenth outside the ninth to account for precession. Apart from the Empyrean, then, the heavens were thought to resemble a set of those curiously carved Indian balls which consist of several hollow spherical shells one within the other. The tenth and outermost sphere is the first moved, the *primum mobile* of medieval philosophy: a sphere which, by its diurnal motion from east to west, controls the motion of all inferior material things. Within this tenth sphere are set the other nine as wheels within wheels: each of these is affected by a proper motion of its own about the earth—a motion which is slower than that of diurnal rotation, and proceeds in an opposite direction from west to east; yet each sphere is linked up with all spheres outside itself, and is, in consequence, influenced by the circular motion of these enclosing spheres. Moreover, the Schoolmen differed from Aristotle on the question of the movers of these spheres. Aristotle attributed the motion of the *primum mobile* to God, and the proper motion of each of the other spheres to an unchanging immaterial form. The Schoolmen attributed the motion

of the *primum mobile* to God—or an angel—and the proper motion of the others to angels.

The Schoolmen followed Aristotle in contrasting the uniform motions and incorruptible nature of the heavenly bodies with the irregular motions and corruptible nature of all sublunary bodies. They insisted, as he did, on the commanding influence of those heavenly bodies over all terrestrial bodies. The heavenly bodies are "perfect without blend of contraries, being neither light nor heavy, neither hot nor cold." They control all the movements on our earth. When the sun is mounting the zenith, earth and water are drawn up and changed into air and fire: heat is increased. When the sun is descending and, finally, sets below the horizon, this temperature falls, and air and fire are changed into earth and water. All meteorological facts in the sublunary world are regulated by the stars: if astronomers knew accurately the complex interactions of heavenly bodies, they could foretell with certainty the coming of showers, of temperatures, of storms. The diversity of the four seasons and the resulting birth, growth, decay, and death among living beings is due to the motion and light of the heavenly bodies and, particularly, of the sun. In the absence of the sun, the moon controls the tides, and also exercises countless effects on plants and animals. There is practically no limit to the influences exercised on the human body by the stars—in conception, gestation, birth, health, sickness: hence, a knowledge of astronomy is absolutely essential to doctors. But although everything physical on earth was directly affected by the activities of the heavenly bodies, the course of these terrestrial motions was not solely determined by them: the results attained depend also on the conditions and capacity of the terrestrial patients. Moreover the heavenly bodies are not arbiters of human will and conduct, except remotely: the rational soul is never *directly* affected by the action of these heavenly bodies; it is affected, however, indirectly owing to its union with a body—but, in normal humanity, this indirect influence does not destroy the fact of free-will. The chief agencies, to which the Schoolmen assigned this commanding influence of the heavens, were local motion and light. And when this manner of refunding sublunary facts to heavenly influences failed them, they had recourse to the occult powers of the heavens. This appeal to the occult was a necessary sequel of their false notions about the higher perfection of heavenly bodies, and of their false theories in physics and biology: whenever a fact or an alleged fact cropped up that could not be explained either by the motions or light of the heavenly bodies, or by the theory of the four elements and its crude concomitant in physiology, the theory of the four humours, it was attributed to the occult influence of some heavenly body; the most frequently cited examples of these occult influences being the alleged spontaneous generation of living beings, and the alleged heavenly generation of metals and gems in the recesses of the earth. So far, the Schoolmen were genuine Aristo-

telians. They outstrip Aristotle, however, in a certain sympathy for astrology : succumbing, therein, to the doctrines of the Neo-Platonists and of the Arabians. Their theory was Aristotelian : astrologers could predict with certainty the future motions of the heavenly bodies, and could predict with probability the future influences of heavenly upon terrestrial bodies. Their practice was tinged with Neo-Platonism : occasionally, their writings are disfigured by the baubles of astrology.

Thomist and Scotist disagreed as to the means by which this heavenly control was brought about. St. Thomas [31] and his disciples held that Aristotelianism involved the essential causal subordination of all physical sublunary motions to the local motion of the heavenly bodies, and ultimately to the local motion of the first moved, the prime minister of corporeal creation. For the Thomist, terrestrial agents are applied to action by the motion of the heavenly bodies just as tools are applied to action by the hands of the workman ; the action of all sublunary bodies proceeds from themselves, not only through their own power but also through that of the celestial bodies ; and, therefore, the influence by motion of heavenly bodies on all terrestrial effects is as immediate as that of their respective terrestrial causes. St. Thomas supported this interpretation of the influence of heavenly motion by a profusion of arguments. Were there no intermediate heavenly causes to carry into execution in sublunary affairs the decrees of Divine providence, there would be in the corporeal world no order of causes : that would be a defect. The higher the natural position of any body, the nobler its form and the more extensive its activity : hence the heavenly bodies must act on terrestrial bodies. The more powerful agents necessarily control the less powerful : but heavenly bodies are more perfect and, therefore, more powerful than terrestrial bodies. Intelligent creatures are the intermediaries by which the rest of the terrestrial creation is governed : but the heavenly bodies are like intelligences because incorruptible, and near them because immediately moved by them. All motion implies a motionless prime mover as source ; therefore, the closer a body approximates in nature to this motionlessness, the greater must be its power of moving inferior bodies. The motionless prime mover is the source of all motion, and therefore some relatively motionless being must be the source of such and such motions : hence, the qualitatively changeless heavenly bodies must be the source of all alteration in alterable bodies, alteration in its turn the source of growth or diminution and generation, generation in its turn the principal cause of the local motion of heavy and light bodies. These are the main points of all the arguments but one in a chapter on this topic from the *Contra Gentes* (III, c. 82). That one is worth transcribing in full for it seems to be the foundation-stone of this particular Thomistic thesis. " Whatever is primary in any genus is the cause of those that come after it. But the motion of the heavens is primary among all other motions.

The first reason for this primacy is that local motion is the first of all motions: it is the first from the point of view of time, because, as proved in the *Physics* (b. 8, tt. 54 sqq.), it, and it only, can be perpetual: it is the first from the point of view of nature, because no other motion can take place without it—for augmentation follows on a preceding alteration by which the unlike is changed into the like, and this preceding alteration is impossible without a preceding local motion, because alteration can take place only when the alterative agent is nearer than it was to the alterable patient; it is first from the point of view of perfection, also, because local motion does not cause any internal changes in a thing but causes merely an extrinsic change, and, on that account, can occur in an already perfect being. The second reason (for the primacy of heavenly motion) is that circular motion is first amongst even local motions; it is first in time, because, as proved in the *Physics* (8, text. comm. 64), it, and it only, can be perpetual; it is first in nature, because it is more simple and more one since there is no distinction in it between the beginning, the middle and the end—the whole of it being in some sense a middle; it is first even in perfection, because it bends back on its beginning. The third reason (for the primacy of heavenly motion) is that the motion of heaven is the only motion that is always regular and uniform: for, there may be an increase of velocity in the natural motions of heavy and light bodies. (For these three reasons), therefore, it follows that the motion of the heavens is the cause of all other motions." This single chapter of the *Contra Gentes* embodies all the principles and all the arguments that St. Thomas and his disciples bring forward, whenever they are defending this theory of heavenly causality. The theory is a kind of metaphysical feudalism. Feudalism was dominant in government in those days, and St. Thomas propounded an order of nature and of divine providence in accordance with this dominant idea. "The order of causes," he writes,(32) "must answer to the order of effects because effects are proportioned to their causes. It follows, then, that special effects must be traced to special causes, and the common feature of these special effects to some common cause. For instance, over and above the particular causes of this or that generation, the sun is the universal cause of all generation: and the king is the universal cause of government in his kingdom above the officials of the kingdom, and also above the officials of individual cities." As a consequence of this theory of heavenly influences, the Thomists taught that if the movements of the heavenly bodies were to stop, all terrestrial physical motions—substantial, quantitative, qualitative, local—would cease simultaneously: and when challenged with the scriptural account of the stoppage of the sun and moon at the request of Josue, they declared that the persistence of terrestrial motions on that occasion was a distinct miracle.

Scotus,(33) Suarez and their disciples allowed that the heavenly

bodies may be truly called universal causes, but refused to interpret the universal causality as due to the essential causal subordination of terrestrial to heavenly bodies. No secondary cause is, they argued, essentially dependent in its causality on any created being: essential subordination in causality is the sequel of essential subordination in existence, and can occur, therefore, only between the creature and the Creator. They argued, also, that essential causal subordination would imply immediacy of supposit or immediacy of power: immediacy of supposit is impossible, because of the distances that separate heavenly and earthly bodies; immediacy of power is thinkable only as diffused power, and that diffusion is either not proven or where proven is interpretable as supplementary co-ordinate causality. Scotist and Suarezian get rid of the Thomist interpretation simply by denying that all physical motion requires a preceding local motion. The gist of their own theory is that heavenly causality is sometimes necessary and sometimes unnecessary for terrestrial bodies; but that, even when necessary, it never implies essential subordinate causality. Some terrestrial causes are imperfect in their own order and insufficient for certain effects: hence, these require the help of the heavenly bodies. Well-known instances of this type are the generation of metals and gems, of perfect mixtures and of living bodies; metals and gems are generated by the heavenly bodies; the four elements do not contain, either formally or eminently, the substantial form of a perfect mixture; perfect mixtures themselves are confessedly very weak in the power of generating their like; plants depend, in growth and in reproduction, on the heavenly bodies; animals, also, depend a good deal on the heavenly bodies in procreation—sun and man are commonly said to generate man, because human seed is of itself weak and can fulfil its function only by aid of the heat of the sun. To maintain, despite these facts of the imperfect powers of certain bodies and of the opposition to the activity by other bodies arising out of unfavourable environment, that continuity which is essential to the order and progress of the universe, Providence has set on high the heavenly bodies: each with a wide range of activities, and each with a never-failing motion. There are terrestrial agents, however, which, so far as observation or reasoning can enlighten us, produce their effects independently of the local motion of the heavens: fire can generate heat whatever be the positions or motions of the heavenly bodies. And in that, and all similar instances where the terrestrial agent is sufficient either of itself or with the aid of other terrestrial agents to produce its effects, it does produce them without essential subordination to the local motion of the first moved or any of its supralunary sub-agents. And even in those instances where a terrestrial cause is insufficient either of itself or with the aid of other terrestrial causes to produce certain effects, and where owing to some incidental circumstance it is deprived of the needed co-operation of the heavenly bodies, perhaps even resisted

by these latter, still, it produces, in virtue of whatever power it can muster, some kind of effect.

Physical Motion and the Infinite.

"He announces," writes St. Thomas,[34] commenting on Aristotle, "the presuppositions of motion. To begin with, a first mover which is the source of motion. Secondly, a mobile that is put in motion. Thirdly, time during which the motion takes place. And in addition to these three, two terms are necessary: one from which the motion begins and another to which it proceeds, for all motion is from something to something." St. Thomas proceeds to illustrate these conditions in the simplest way: fire as first mover heats wood; wood as mobile is made hot by fire; this process of heating takes time; the term from which the process starts is the quality of cold in the wood; the term towards which the process proceeds is the quality of heat in the wood. The same five conditions and the same simple illustration figure also in the Commentary of Scotus on Aristotle. Yet, as we have seen, Aristotle and the Schoolmen found themselves compelled to raise question after question on this problem of causality: the fact and the meaning of causality; the nature and seat of action, passion and motion; the proximate principle of causality in the agent; contact, unlikeness, and, the distinction between mover and moved, as conditions of causality; the influence of the heavens on terrestrial motions. The more important aspects of medieval speculation on these and cognate topics have been discussed as far as space permitted. But in addition to all these questions, there is another fundamental presupposition which must never be forgotten by the student who wishes to grasp the medieval theory of physical motion: that of an immediate divine concurrence. The explanation of that presupposition belongs to the treatise on Natural Theology. Here it must suffice to state that, during the middle ages, practically the whole School [35] held there was irrefragable *philosophical* proof of the necessity of an immediate divine concurence in all physical motions: somehow or other, finite causality abuts on the Infinite. Despite this unanimity of opinion about the fact itself and about the existence of its philosophical proof, Thomist and Scotist and Molinist were never able to agree about the inner details of this fact. All three Schools postulated a simultaneous concurrence: Thomists postulated in addition an intrinsic physical premotion which consists in some kind of premoving physical quality; Scotists rejected this intrinsic premotion but postulated an extrinsic premotion which consists in an absolute and efficacious divine decree; Molinists rejected any kind of premotion whether intrinsic or extrinsic. *Non nostrum inter vos tantos componere lites.*

CHAPTER X.

THE ECLIPSE OF ARISTOTELIAN COSMOLOGY.

"There are two ways of behaving towards St. Thomas's writings, analogous to two several treatments of a church still standing, in which the saint might have worshipped. One way," proceeds Fr. Rickaby, S.J., in a preface to his translation of the *Summa contra Gentes*, "is to hand the edifice over to some Society for the Preservation of Ancient Monuments: they will keep it locked to the vulgar, while admitting some occasional connoisseur: they will do their utmost to preserve every stone identically the same that the medieval builder laid. And the *Opera Omnia* of St. Thomas, handsomely bound, may fill a library shelf, whence a volume is occasionally taken down for the sole purpose of knowing what St. Thomas said and no more. Another thirteenth-century church may stand, a parish church still, in daily use; an ancient monument, and something besides; a present-day house of prayer, meeting the needs of a twentieth-century congregation; and for that purpose refitted, repainted, restored, repaired and modernised; having that done to it which its medieval architects would have done, had they lived in our time. Nothing was more remarkable in our old English churches than the sturdy self-confidence, and the good taste also lasting for centuries, with which each successive age has superimposed its own style upon the architecture of its predecessors. If St. Thomas's works are to serve modern uses, they must pass from their old Latinity into modern speech: their conclusions must be tested by all the subtlety of present-day science, physical, psychological, historical: maintained, wherever maintainable, but altered where tenable no longer. Thus only can St. Thomas keep his place as a living teacher of mankind." This quotation expresses admirably the aim of this Cosmology. The volume which has been completed purports to give the Cosmology of Aristotle and the School exactly as these ancient architects built it. The second volume is intended to test that Cosmology by all the subtley of modern science and of modern philosophy. And this present chapter is written to explain the causes of the eclipse of Scholastic Cosmology from the seventeenth to the middle of the nineteenth century. That Cosmology sprang from certain intellectual conditions. That is why when expounded in reference to the science of the times when it originated and developed, many a phase that seems abnormal shows a

reasonable meaning. So natural a growth was this Cosmology in the eyes of Aristotle and of the School that they never dreamt it could disappear from the universities of the West: for them, it was like Tennyson's "tower of strength, that stood four-square to all the winds that blew." A day came, however, when all the fury of an alien civilisation was directed against the Cosmology of the School, and as a continual dropping wears away the stone, so blow after blow sufficed first to render unpopular in, and at last to banish from, the universities of Europe, Aristotle's Philosophy of Matter. First came the Humanists, then Copernicus, Kepler, Galileo, then Descartes and Newton, then Lavoisier and Cavendish.

The Gibes of the Humanists.

The first revolt against the philosophy of the School was launched by the men of the Renaissance. That movement held full sway in Western Europe between 1400 and 1600. Its strength lay in its disinterested championship of scholarship and its rehabilitation of the joy of life: a return to the springs of creative Hellenism. Its religious defect lay in an unbridled liberty of mind and heart that degenerated into eccentric and even sinister emotionalism: the religion of Greece was set up as a rival of the religion of Christ. Its educational defect lay in a tendency to regard the classics of Greek and Rome as the sole standard of learning and the sole instrument of mental training. It was from this last point of view that the Humanists started their campaign of ridicule against the philosophy of the School. Rabelais makes himself the mouthpiece of all their grievances in the following description of a visit made to the Queendom of Whims or Entelechy. "We met on the Key a great number of Guards. . . . The Captain told us:—Aristotle, that first of Men and peerless Pattern of all Philosophy, was our Sovereign Lady's Godfather; and wisely and properly gave her the Name of Entelechy. Her true name then is Entelechy. . . . The Captain afterwards took us to the Queen's Palace, leading us silently with great Formality. . . . She looked young, though she was at least Eighteen hundred years old; and was handsome, slender and as fine as a Queen, that is, as hands could make her. . . . The officers desired us not to take it amiss if the Queen did not invite us to dine with her; for she never ate anything at Dinner but some Categories, Abstractions . . . Second Intentions . . . Antitheses, Metempsychoses, Transcendent Prolepsies and such other Light food. . . . I then, saw a great number of the Queen's officers who made Niggers white as fast as hops. . . . Others with three couples of Foxes in one yoke plowed a sandy Shore and did not lose the seed. . . . Others sheered Asses and thus got Long-fleece wool. . . . Others gathered Barberries and Figs off Thistles. . . . Others taught Cows to dance and did not lose their fidling. . . . Others built

Churches to jump over the Steeples. . . . Others set Carts before the Horses. . . . Others out of nothing made great things, and made great things to return to nothing. . . . Others cut Fire into stakes with a knife and drew Water with a Fish-net. . . . Others made a Virtue of Necessity and the best of a bad Market, which seemed to me a very good piece of Work. I saw two by themselves, keeping Watch on the top of a Tower; and we were told, they guarded the moon from the Wolves. In a blind Corner, I met four very hot at it, and ready to go to Logger-heads. I asked what was the cause of the stir and ado, the mighty coil and pother they made? And I heard that for four live-long days, those over-wise Roisters had been at it ding-dong, disputing on three deep, more than Metaphysical Propositions, promising themselves Mountains of Gold by solving them. The first was concerning a He-Asse's shadow: the second, of the Smoke of a Lanthorn; and third of a Goat's Hair, whether it were Wool or no? We heard that they did not think it a bit strange that two Contradictions in Mode, Form, Figure and Time should be true. Though I will warrant the Sophists of Paris had rather be unchristened than own so much. While we were admiring all those Men's wonderful doings, the Queen . . . appeared, attended with her Court, and again amazed and dazzled us. She perceived it and said to us. 'What occasions the Aberrations of humane Cogitations through the perplexing Labyrinths and Abysses of Admiration, is not the Source of the Effects, which sagacious Mortals visibly experience to be the consequential Result of Natural Causes; 'Tis the Novelty of the Experiment, which makes Impressions on their conceptive cogitative Faculties that do not previse the facility of the Operation adequately, with a subact and sedate Intellection, associated with diligent and congruous Study. Consequently, let all manner of Perturbation abdicate the Ventricles of your Brains, if anyone had invaded them while you were contemplating what is transacted by my Domestic Ministers. Be Spectators and Auditors of every particular Phenomenon and every individual Proposition within the extent of my Mansion, satiate yourselves with all that can fall here under the Consideration of your visual or auscultating Powers, and thus emancipate yourselves from the Servitude of Crassous Ignorance. And that you may be induced to apprehend how sincerely I desire this, in consideration of the studious Cupidity, that so demonstratively emicates at your external Organs, from this present Particle of Time, I retain you as my Abstractors. Geber, my principal Talachin, shall Register and Initiate you at your departing. We humbly thanked her Queenship without saying a word, accepting of the Noble Office she conferred on us." All this, and there is much more of it, is excellent fooling, when it is not worse. But if one remembers that these are the gibes of men who believed as firmly as did the Schoolmen in the empirical science of Plato or Aristotle, this first assault on the School is seen to be sheer pedantic sentimentality:

and as such, it was met fully and fairly by Vasquez in the opening pages of his Commentary on the *Summa*. His defence was meant for the theology of the School: as against the gibes of the Humanists, it applies equally well to the philosophy of the School.

The Retort of Vasquez.

"First of all we cannot deny that there have been very many . . . in the School who have treated . . . questions in a frivolous manner. . . . But that is not the fault of the science . . . it was the misfortune of the times in which minds were not cultivated, nor arts so elaborated, nor books so abundant. Now that there is a better supply of books and much greater exercise of intellect, our scholastic theology . . . is daily enriched and treated in a more deserving manner. . . . Secondly, many even Catholics inveigh against scholastic theology in the following way. There are very many doctors seemingly born for disputation, contentious party men, who are less anxious about the investigation of truth than about the defence of their own School and of that Master to whom they have sworn allegiance. And by this kind of action no small injury is done to theology and to truth. . . . But that, so far as it is a fault, is not a fault of Scholastic theology, but a fault of personal character. . . . Francis Victoria, a disciple and keen defender of St. Thomas, used to say (and he is followed by Melchior Canus . . .) that the authority of St. Thomas ought so far to prevail as to suffice for us, if a better reason be not forthcoming: still, that the words and reasons of so great a Doctor were not to be accepted without discrimination and examination. Moreover, if St. Thomas laid down anything not altogether probable, that we ought to imitate the Saint's own modesty and industry, in neither disparaging the credit of ancient Doctors nor adopting their opinion if reason urged to the contrary. Wherefore he wishes us not to be so attached to the doctrine of St. Thomas as to think it a crime to depart a hair's breadth from any reason, ground, opinion or conclusion of his. . . . For we see that some famous authors of the Thomistic School, nay, the keenest defenders of the teaching of St. Thomas—men like Cajetan, Francis Victoria, Dominicus Sotus, Melchior Canus, Bartholemeus Torrensis who have written wonderful commentaries on his text—do not believe they are guilty of any offence towards this holy Doctor when they, occasionally, and as a result of deep thought, modestly dissent from one or other of his views. For these men did not believe that the Angelic Doctor wished his views to be embraced under any other conditions than those which Augustine laid down about his own when . . . he writes: '*I should wish no one so to embrace my opinions as to follow me except on points in which he sees that I am not mistaken. For that reason I am now writing my Retractations to show that I have not in all things followed myself.*' . . . But you see some people who purposely set out to refute the teach-

ing of St. Thomas, and then fancy they have done something glorious when they have uttered a pronouncement against an opinion of his. . . . These deserve no light blame : and they are undoubtedly creating obstacles for their own pursuit of truth. The above-mentioned Thomists, then, teach that such disinterestedness and sincere desire of truth should rule our treatment of questions, which are not dogmas of faith but are doubtful and probable matters, that despite our respect for the authority of the Blessed Thomas, reason, maturely pondered, should hold the first place, whenever such reason can be discovered. . . . If, therefore, many theologians go astray in their treatment of theological disputes, that is their own fault. . . . And the science of Theology ought not to be despised on their account. . . . Thirdly, some are offended at scholastic theology for its style : its uncultured mode of speech, its mean and vulgar phraseology, its barbarisms and solecisms. These are the votaries of Rhetoric and Eloquence : men who delight in words rather than facts ; men who neglect to investigate the natures and properties of things or to examine the difficulties of things ; men who hate the very name of Scholasticism. Herein they are far from following that oracle of theirs, Cicero. . . . For he, when mentioning Epicurus in his book, *de Finibus*, writes : 'The style of this philosopher does not offend me : for he puts into words what he means and speaks so plainly that I understand him ; and though if a philosopher brings eloquence, I do not despise it, yet if he has it not, I do not demand it.' . . . This barbarism and unskilful language of the Schoolmen is to be attributed rather to the fault and misfortune of the age than to the doctrine itself. That doctrine would not lose its force and instructiveness by being treated in a purer style. Moreover, that doctrine does not require for its treatment and its exposition an extended vocabulary, much eloquence, and oratorical style ; only a few words to unite the knot of any difficulty and a plain brief style which will not be a source of obscurity but a help in disputation. . . . Fourthly . . . while it may be true that several questions treated by the older and recent Schoolmen are not of much importance to theology . . . Still, there are other questions which are common to theology and to philosophy. . . . I grant that some of these common questions are of little use from the pious point of view : but that does not show their uselessness in theology. Neither does that multiplication of questions and articles, which some are always crying down, make theology useless. This fault, if it be a fault, arises solely from the extensive curiosity of the Doctors. Further, subtle questions of that kind are excellent for sharpening people's wits. . . . Hence a theology which examines sincerely only theological problems—or even philosophical problems that are pertinent to theology—is not to be scoffed at and ridiculed. *Vale*, then, to these Rhetoricians, who think nothing worth studying except *Literæ Humaniores*."

This plea of Vasquez has more good sense to the line than

almost any other subsequent apologia. Time vindicated him and the School. That type of Humanist, who in the sixteenth century denounced the School, showed himself in his true colours in the eighteenth century by denouncing the "Philanthropists," that is, the students of mathematics, of modern sciences, of modern languages and of history: with the result that the term, Humanist, became a byword of contempt denoting one who delights more in words than in facts. And when the historical criticism of the nineteenth century set to work on the philosophy of the middle ages, students discovered and exposed the flimsy basis of the gibes of the Humanists: to-day, every competent critic admits the seriousness of the attempt made by the abler Aristotelian Schoolmen to explore all sources of knowledge, available in their day, for the purpose of discovering a rational solution of the riddle of the universe.

Anti-Aristotelian Discoveries in Empirical Science.

The genuine assault on the Cosmology of Aristotle and the School began with those scientific discoveries that ushered in modern astronomy, physics, and chemistry. Astronomy was the first to enter the lists. Copernicus (*De Revolutionibus*, 1543) taught that the sun is at rest in the centre of our universe and that the earth and planets move round it as centre: he admitted, however, uniform circular motion for all heavenly bodies and the existence of crystalline spheres. Tycho-Brahé by measuring the parallax of the comet of 1557 showed that comets were stars extraneous to our atmosphere, and not sublunary will-o'-the-wisps; in 1572, he discovered in the constellation of Cassiopeia a new star, that at first shone more brightly than all the fixed stars but later waned and finally disappeared in March, 1574. Kepler (*The Motions of Mars*, 1609) taught that the planets move in ellipses. Galileo (1564-1642) discovered by means of the telescope new stars in several of the constellations: he also discovered movable spots on the disc of the sun, and the valleys and mountains of the moon. Thus, within one half century, all that Aristotelians believed about the superior perfections and the nobler motions of the heavenly bodies was proven untrue. Physics, then, entered the lists. Otto von Guericke's discovery of the air pump (1650) enabled physicists to prove experimentally the weight of air: thereby confirming Galileo's conclusion drawn from weighing flagons of compressed air. Newton's discovery of gravitation (*Principia*, 1687) was taken as proof of the weight of all four elements. But the great seventeenth century antagonist of Aristotelian natural science was Descartes (1596-1650). Descartes revived the physics of that ancient enemy of Aristotle, Democritus: led thereto, far more than he was wont to admit, by the scientific successes of his contemporaries. The revival of this ancient quarrel between Democritus and Aristotle broke up the serried ranks of seventeenth-century Scholasticism:

pitting Catholic against Catholic, Protestant against Protestant, University against University, Order against Order. It created immense excitement in France and Belgium and Holland: princes and bishops took sides; churches and parliaments issued edicts; salons lionised the more famous protagonists; lampoons and libels were bandied about. After a fierce controversy, Cartesianism triumphed in the worlds of science and of letters. Its triumph, there, was short-lived. Voltaire and Maupertius introduced into France Newton's theory of gravitation: and after an equally fierce but much shorter struggle, the vortices of Descartes became in France as unpopular as had been the substantial and accidental forms of the Schoolmen. But whether Newton or Descartes won, Aristotle lost. Henceforth, every material event was explained by physicists as a group of particles—with or without inherent motive forces—moving in accordance with the laws of mechanics. And when the Physicists had thus scotched the theory of the four elements, the Chemists stepped in to give it the death-blow. The fundamental point of this theory was that air, water, earth, fire, were four unanalysable ultimates out of which all other bodies are made. Boyle (1627-91) tried to discredit that teaching by chemical analysis. His successors succeeded in disproving it experimentally: Lavoisier (1743-94) and Cavendish (1731-1810) succeeded in analysing air and water; Davy (1778-1829) and Berzelius (1779-1818) decomposed various earths. The first chemists blundered over fire. Already in the sixteenth and seventeenth centuries, many physicists had made up their mind that fire was not a substance but an intense grade of heat: Cardan (1550), Descartes and Newton advocated this view. Chemists held, however, that fire was a substance: Stahl propounded in 1697 the theory of phlogiston; Lavoisier, who destroyed that chimera, bequeathed the theory of caloric. But the experiments of Davy and Rumford (1753-1814), showing that a definite quantity of heat could be produced by a definite amount of mechanical work, convinced chemists as well as physicists that heat was some form of motion. At that stage, not a trace was left of all those theories of empirical science on which Aristotle, St. Thomas, and Scotus had built their Cosmology.

A Break with the Tradition of Aristotelian Scholasticism.

No one, who has developed the historic sense, scoffs at Copernicus because he did not know of Kepler's Laws or at Newton because he did not know of Einstein's Theory of Relativity. The same reason should prevent anyone from scoffing at the Aristotelian Schoolmen who wrote before the seventeenth century because they did not write as Keplerians, Cartesians, Newtonians. In those earlier centuries, a Keplerian, a Cartesian, a Newtonian was as impossible as an Einsteinian. But the Aristotelian Schoolmen [1] of the thirteenth century did make a fight for

truth which ought to have been a guiding light to those successors of theirs that had to face the disproof by the scientific world of the empirical science of Aristotle. It was the glory of the first Aristotelians among the Dominicans and Franciscans to have broken, in the interests of science, with that earlier Scholasticism which was founded mainly on the Neo-Platonism of St. Augustine. Arabians and Jews had at that time begun to handsel the Aristotelian writings for the purpose of destroying the Catholicism of Europe. And these Catholic pioneers averted the danger by personal study of Aristotle: proving, text in hand, that his encyclopædic erudition and rationalistic metaphysics was either necessary to or compatible with the dogmas of faith. "Our intention," declares Albert the Great,(2) "is to make all the parts of Aristotle, physics, metaphysics and mathematics, intelligible to the Latins." Nor did this loyalty to Aristotle imply any unreasonable servility. "He who thinks that Aristotle was a god," declares Albert,(3) "is bound to hold that he has never made a mistake. But those who believe he was a man are bound to admit that he can go astray just as we do." St. Thomas and Duns Scotus worked, also, along those lines with the result that Aristotle was firmly enthroned as the guide in Philosophy of the School. In this reform of Philosophy, Albert, St. Thomas, and Scotus, are but types of that thinker in every crisis of human progress who wins for mankind a new kingdom of truth not opposed to but only beyond and independent of the truth already discovered. Such pioneers have always to encounter a fierce and angry opposition from the defenders of what, at that moment, has to be shown up as out-worn human learning. The adherents of a poorer, narrower outlook have no sympathy with, because no understanding of, a culture more ample than their own: after the discovery of wheat, they would continue to live on acorns. Thus it happened that Oxford and Paris, the famous universities of the age, condemned again and again this nascent Aristotelianism of the School: for the authorities of these universities, Aristotelianism was inseparable from that curse of the thirteenth century, Averroism. This ineffectual opposition to St. Thomas and to Scotus did but give colour to their personalities, and prove them to be of the same calibre as the truth-seekers of every other age: not intransigeant partisans of the past; not special pleaders *pro domo*. Both of them knew that the mind of man, driven by an irresistible urge towards the pursuit of truth, will not brook for long worthless man-made traditions. "An appeal to any merely human authority is," writes St. Thomas, (4) "the feeblest of all arguments." This clear duty of the Aristotelian Schoolman to accept truth from whatsoever source it comes was unfortunately neglected by those Schoolmen who, from the seventeenth to the middle of the nineteenth century, had to grapple with the task of reconciling Aristotle's Cosmology with the new discoveries of modern science. They refused to try to accommodate Aristotle's Cosmology to

these truths either by mending or ending it: thereby, breaking with the foundation-stone on which Aristotelian Scholasticism was built in the thirteenth century.

This scientific intransigeance of the School [5] began with the controversy on Copernicanism. At first the Schoolmen affected to ignore the existence of any such doctrine: writers of the calibre of Suarez and of John of St. Thomas make no mention of heliocentrism. And when the march of events compelled them [6] to take notice, the majority during the seventeenth and eighteenth centuries rejected this theory root and branch: the only concession, they made to the new astronomy, consisting in various ineffectual emendations of Ptolemy. Three extenuating pleas may be mentioned: Aristarchus of Samos had three centuries before Christ defended a form of Copernicanism, and Ptolemy had declared this theory absolutely ridiculous; many astronomers followed Tycho-Brahé in rejecting the views of Copernicus; for a long time, the Copernicans themselves taught their theory merely as a mathematical hypothesis useful for explaining appearances. Of course these decadent Schoolmen mooted all sorts of doubts about the new astronomy: may not one admit spheres that revolve within one another? may not one admit heavenly canals through which the stars move? are comets always natural facts? are the observations of the astronomers so very certain? But despite the obstinacy of the Ptolemaists, Copernicanism marched from conquest to conquest. In 1728, the actual state of this controversy was described, as follows, by Jerome of Montefortino. "The opinion of philosophers regarding the nature of the heavenly bodies is banished long since from the schools (of astronomy) by absolutely certain observations which show that the sun and moon and other stars are made of the same kind of stuff as our earth: the result is a strong confirmation of the doctrine of the saints that God made all things. We think it useless to enter here on a discussion of the fables of the philosophers—Aristotle and his commentators. St. Thomas and Dun Scotus would, no doubt, have thought the same, had God deigned to reveal in their day all that He has made known to their successors concerning the heavenly bodies."

The new discoveries in physics and chemistry were treated by these Schoolmen in much the same way. Some of them [7] admitted in the seventeenth century the gravity of air: others [8] continued to assert its levity. But, in that century, hardly any Schoolman admitted the gravity of fire although some,[9] at a later date, attributed to fire only a relative levity, that is, a less weight than the other three elements. And all through the seventeenth century, the School [10] continued to teach that cold and wet are positive qualities and not merely the absence of heat and dryness. So much for the four qualities. The Schoolmen of the seventeenth and eighteenth centuries were even more stubborn concerning the existence of four elements: encouraged, thereto, by the fact that, outside the School, some non-Aristotelian

philosophers and scientists continued to teach the existence of four elements. One group of Schoolmen [11] continued to defend this theory by the traditional arguments: these were very numerous in the seventeenth century, less numerous in the eighteenth, a remnant in the first half of the nineteenth century. All these laid great stress on the argument from authority. "I implore you, young people, by the Almighty and by all the Saints that Spain has sent to heaven," writes Puigserver, in a preface, "not to allow yourself to be led astray by these men whose boast it is to despise all the ancients." Another group of Schoolmen [12] took a different line: they stuck to the theory in its general outlines, but they compromised about matters of detail, and they expressed doubts about the value of the traditional proofs. From about 1830 to 1850 another group of Schoolmen [13] got out of this embarrassing choice between the old science and the new, simply by omitting from their philosophical treatises either all Cosmology or, at least, the problem of the ultimate constituents of matter. Finally, from the middle of the eighteenth century onwards, a number of Scholastics [14] accepted the theory of Boscovich: thereby proclaiming their conviction of the impossibility of reconciling the hylemorphism of the ancients with the science of the moderns.

The Boscovichians may have made a hasty choice: they cannot be accused, however, of disloyalty to that guiding principle of the thirteenth century—hear all sides. But if it be, in the words of the *Aeterni Patris*, "a calumny on that (scholastic) philosophy to say that it is opposed to the advance of the physical sciences," no one can deny the break with the Aristotelian tradition during these centuries. That decay arose, mainly, out of the exaggeration of two characteristics of later Scholasticism. "It was *legalist* and it was *a priorist*. Law, even more than philosophy, was the favourite pursuit of the medieval scholar. A knowledge of the canon and civil law was the surest avenue to preferment and wealth. Hence arose a tendency to treat philosophy like law. Aristotle was cut up into texts, which were quoted like texts from the Pandects. A like use was made of the Fathers and Holy Scripture, and, as time went on, of the great Schoolmen who had gone before. The danger of this practice was a neglect of context and spirit, and a losing sight of the intrinsic grounds of the argument. Scholasticism was also *a priorist*, making out what must be in the nature of things. Now it is easy to make out what must be, to our minds, so far as our knowledge goes and our hypothesis extends. The difficulty is in testing our hypothesis by experiment and observation, and widening our knowledge by research into actual facts, unfavourable as well as favourable to our preconceived theory. This rough and tumble *a posteriori* work was not much to the taste of some of the Schoolmen and their speculations suffered accordingly." [15]

THE LEONINE REVIVAL OF ARISTOTELIAN SCHOLASTICISM.

The experiment of welding together the science of the moderns and the philosophy of the Aristotelian Schoolmen was begun in the Catholic Schools in the second half of the nineteenth century. Leo XIII crowned that experiment by insisting that it should be a nineteenth century revival of the spirit of the thirteenth century Aristotelian reform. This Pope in the *Aeterni Patris* (1879) urged Catholic philosophers to follow a living not a dead Scholasticism: to reject everything that St. Thomas and Scotus, were they now alive, would reject; to carry forward through seven centuries the teaching of these Masters and yet be, in every innovation, Scholastics. "St. Thomas, Blessed Albert the Great, and other leaders of the Schoolmen, for all their study of philosophy spent much of their energies in seeking to acquire knowledge of the facts of physics. . . . While, then, We pronounce that every wise saying, no matter who said it, every useful invention or contrivance, no matter who discovered it, is to be willingly and gratefully taken up, We earnestly exhort you all . . . for the defence and adornment of the Catholic Faith, for the good of society, for the advancement of all sciences, to restore the golden wisdom of St. Thomas, and propagate it far and wide to the best of your power. The wisdom of St. Thomas, We say: for if there be in the Scholastic Doctors any excessive subtlety of inquiry, any inconsiderate teaching, anything less consistent with the ascertained conclusions of a later generation, in a word, anything in any way improbable, We have no mind to hold that up for the imitation of our age."

The starting-point of this reform in Cosmology is the rejection of the out-worn learning of the Schoolmen: their obsolete astronomy; their mistaken physics; their total ignorance of chemistry; their *a priori* aversion to any form of atomism or of kineticism; their reliance on the Aristotelian method of scientific proof rather than on observation and experiment and *a posteriori* methods generally. The next step in this reformation is to extract, from the Cosmology of the medieval School, whatever is of perennial value. There is, naturally, some divergence of opinion amongst contemporary Schoolmen regarding details. But, apart from these open issues, most contemporary Schoolmen are agreed that the Cosmology of the Aristotelian Schoolmen, when vindicated from the ravages of time and from the still worse ravages of injudicious handling, contains a Philosophy of Matter which is more in accordance with the teachings of modern science and the principles of sound metaphysics than any of its present-day rivals. An account of the line of argument that leads up to this optimistic estimate of modern Scholastic Cosmology will be found in the second volume.

NOTES.

INTRODUCTION.

The mottoes of this volume are taken from Albertus Magnus, *Phys.*, viii, tr. 1, c. 14, and from St. Thomas, *Ethic. Nicom.* i, lect. 6.

The Creation of Rational Science :—(1) Cf. Bury, *History of Greece* (1920), cc. 1, 2. (2) Cf. Grote, *History of Greece*, i, c. xvi; Gilbert Murray, *Four Stages of Greek Religion*, cc. 1, 2; Miss Harrison, *Prolegomena to Greek Religion;* Miss Harrison, *Themis;* Dr. L. Farnell, *Cults of the Greek States;* G. Murray, *Euripides and His Age;* Whibley, *A Companion to Greek Studies* (1906), cc. 3, 5. (3) Burnet, *Early Greek Philosophy* (1920), p. 25. (4) Burnet, *Greek Philosophy* (1914), pp. 10-11.

The Originality of Greek Rationalism :—(5) Burnet, *E.G. Philosophy*, pp. 15-24.

The Religion of Rationalism :—(6) Burnet, *Greek Philosophy*, pp. 11-13.

Rationalism in Revealed Religion :—(7) Cf. Fr. Joseph Rickaby, S.J., *Oxford and Cambridge Conferences* (1900), pp. 61-66; Rev. P. Finlay, S.J., *Divine Faith* (1917), pp. 200-218. (8) *De Revelatione*, can. i. There can be no doubt, then, about the official attitude of the Catholic Church concerning the possibility and necessity of a philosophy of theism. The unofficial mind of our ablest apologists is voiced by Cardinal Billot in his contention that the "five ways" of the *Summa Theologica* of St. Thomas are the only valid proofs of the existence of God. It is almost impossible, however, to bring all this home to the minds of authors who have got little or no training in the Metaphysics of the School. They continue to propound non-Thomistic proofs which are as worthless as they are facile: aids to atheism rather than proofs of theism. At times, they are capable of reverting to a position closely allied to Traditionalism and of maintaining that the miracles of our Lord—for instance, His Resurrection—establish the existence of God quite independently of the philosophy of theism. This attempt to put history on a level with philosophy as an ultimate basis of theism would have been scouted by St. Augustine, St. Thomas, Scotus, Suarez. These masters of Catholic Apologetics would have warned the public that an important part of Catholic Theology must never have been known or must conveniently have been forgotten by such semi-traditionalists. They would have pointed out that the Bible from *Genesis* to the *Book of Revelation* is full of the records of the intervention in our world of spirits good and bad; that century after century there has been an ever-growing accumulation of excellent evidence for this intervention in the lives both of saints and of sinners; that, in fact, the intervention of disembodied spirits in the happenings of this world may be said to be an essential part of the dogmatic teaching both of Judaism and of Christianity from the beginning. Other ditches in this new path, along which popularisers would have their readers find an easy way to the proof of the existence of God, will occur to the mind of every alert student of modern Apologetics. But eschewing these modern difficulties and putting ourselves at the standpoint of the Schoolmen, the question at once arises concerning the historical miracles of our Lord: How can we be sure that these miracles were the work, not of a superhuman spirit but of the Second Person of the Blessed Trinity? To raise that grave question is to blow sky-high the frail card-houses of men who are indolent enough or thoughtless enough to wish to fling on the scrap-heap the rational theism of St. Thomas. For, the only possible way of meeting that question is to reinstate the philosophical proofs of God's existence in that ultimate position which they have always held

in the works of trained apologists. If philosophy can prove that the Maker of man and of man's environment is an infinitely perfect personal God, it follows at once that such a God will not allow the human race to be led astray by preternatural events on the gravest questions of Revealed Religion. But unless philosophy can and does take this first step, preternatural facts cannot bridge the chasm that separates the Superhuman from the Infinite. Thus, the argument from the miracles of our Lord in favour of His Divinity presupposes in ultimate analysis an independent philosophical proof of the existence of God. (9) Fr. Rickaby, S.J., *Oxford and Cambridge Conferences* (1900), pp. 54-61. (10) Idem., pp. 66-67. (11) Idem., pp. 68-69. The Tertullian sentences are quoted out of their order. (12) Fr. Jos. Rickaby, S.J., *Scholasticism* (1908), pp. 118-121. This topic of Rationalism in Revealed Religion must not be confounded with such totally distinct topics as, the divine motive and the supernatural basis of Faith, the proper attitude of born Catholics towards the motives of credibility, the obligations of all Catholics regarding intellectual arguments against Faith, etc. Cf. Fr. Rickaby, S.J., *Oxford and Cambridge Conferences* (1900), pp. 54-62, 70-87 ; do., *In an Indian Abbey* (1919), pp. 47-67 ; Fr. P. Finlay, S.J., *Divine Faith* (1917), *passim.*

Aristotle's Division of Speculative Philosophy or Science :—(13) Taylor, *Aristotle on His Predecessors* (1907), pp. 17-28 ; Joachim, *Aristotle on Coming-to-be and Passing-away* (1922), pp. xiii-xxx ; Zeller, *Aristotle and the Earlier Peripatetics,* i, pp. 171-190.

The Physics of Aristotle :—(14) Mansion, *Introduction à la Physique Aristotélicienne,* cc. 1, 4, 5, 8 ; Joseph, *Introduction to Logic,* p. 350 sqq. ; Joachim, *Aristotle on Coming-to-be and Passing-away,* pp. xxxi-xxxviii ; cf. Chapter iii. (15) Joachim, *Aristotle,* etc., p. xxix.

The Revolt against Aristotelianism :—(16) Cf. Chapter x. (17) Descartes (Cousin's edition), vol. x, p. 255 and pp. 294-296.

Physical Science and Modern Philosophy :—A detailed account of the physical and mechanical theories provisionally sketched in this and the next two sections (The Evolution of Modern Physics, Theoretical Physics and Abstract Mechanics) will be part of the second volume on Modern Cosmology. For that reason, no authorities are quoted at this stage. A wide-ranging defence of the view taken in this provisional sketch can be found in the following books : Merz, *History of European Thought in the Nineteenth Century,* vols. i and ii ; Lucien Poincaré, *The New Physics ;* Mach, *The Science of Mechanics ;* Dannemann, *Die Naturwissenschaften in Ihrer Entwicklung und in Ihrem Zusammenhange,* 4 vols. ; Siegmund Gunther, *Geschichte der Anorganischen Naturwissens chaften in Neunzehnten Jahrhundert ;* Picard, *La Science Moderne ;* Henri Poincaré, *La Science et l'Hypothèse ;* do., *La Valeur de la Science ;* do., *Science et Methode ;* Whetham, *The Recent Developments of Physical Science ;* Bohr, *The Theory of Spectra and Atomic Constitution ;* Eddington, *Space, Time and Gravitation ;* Loring, *Atomic Theories ;* Planck, *The Origin and Development of the Quantum Theory ;* Reiche, *The Quantum Theory.* (18) Joachim, *Theory of Truth,* pp. 69-73.

The Evolution of Modern Physics :—(19) Kundt, *Die neuere Entwicklung der Electricitätslehre* (1891), p. 35.

The Practical Interest of Physical Science :—(20) Merz, *History of European Thought,* etc., i, pp. 326-329. (21) Merz, *History,* etc., i, p. 330, n. 1. (22) Merz, *History,* etc., ii, pp. 207-208. (23) Merz, *History,* etc., ii, pp. 201-202. (24) Rücker, Presidential Address to the British Association, *Report* (1901), p. 5. Cf. Poynting, Address to the Mathematical and Physical Section of the British Association (1899), *Report,* pp. 1-10. (25) Hicks, *Nature,* vol. lii, p. 472. (26) Rücker's Presidential Address, etc., p. 23.

The Manufacture and Diffusion of Irrational Science :—(27) Silvanus P. Thompson, *Life of Lord Kelvin* (1910), vol. ii, pp. 1121-1124. (28) Brewster, *Memoirs of Sir Isaac Newton* (1855), p. 313. (29) *Observations upon the Prophecies of Daniel and the Apocalypse of St. John* (London, 1732), pp. 75-79, 85-86, 113-114, 191-200, 256-272, 279, 282-283, 305, 314-322. (30) *Life of Kelvin,* ii, p. 1087, note. (31) *Life of Kelvin,* ii, p. 1091. (32) Newton, *Observations,* etc., pp. 191-192.

The Purpose of Modern Cosmology:—(33) Taylor, *Elements of Metaphysics*, pp. 48-49. (34) Maxwell, *Matter and Motion*, p. 40. (35) Tait, *Force*, Nature, vol. xvii, p. 459. (36) Aston, *The Atoms of Matter*, Nature, Nov. 25, 1922, p. 702 sqq.

The Utility of Cosmology:—(37) St. Thomas, *Meteor*, iv, lect. 1. The far-reaching consequences of Cosmology in what St. Thomas calls "speculation about divine truth" are strikingly illustrated in many chapters of the late Dr. McDonald's *Motion: Its Origin and Conservation* (1898).

Method in Cosmology:—(38) Pater, *Plato and Platonism* (1907), pp. 8-10. (39) Arist., *de Cœlo*, 279^b 7-12; do., *Met.*, 983^b 1-6; do., *Met.*, 995^a 25-995^b 5; St. Thomas, *de Cœlo*, i, lect, 22; do., *Met.*, i, lect. 4; do., *Met.*, iii, lect. 1; Scotus, *Met.*, i, s. 2, c. 1; do., *Met.*, iii, s. 1, c 1. (40) Arist., *Ethic. Nicom.*, 1096^a 14-18. (41) St. Thomas, *Ethic.*, i, lect. 6. (42) St. Thomas, *de Cœlo*, i, lect. 22.

CHAPTER I.

(1) The works of the Pre-Socratics have not come down to us in their entirety. All that we possess of their writings are either fragments or the accounts of disciples, collectors, commentators. A critical edition of these sources is to be found in the volumes of H. Diels: *Doxographi Græci*, Berlin, 1879; *Fragmente der Vorsokratiker*, Berlin, 1906 (2nd ed.). All fragments, except those of Heracleitus, are quoted from Diels.

The Milesians:—(2) *Met.*, i, 3, 983^b 22. (3) Zeller, *Pre-Socratics*, i, 232 sqq.; Burnet, *Early Greek Philosophy*, 53 sqq. (4) Aet. i, 3, 4. (5) *In Arist. de Cœlo*, 273^b 45; *Schol. in Arist.*, 514^a 33.

The Pythagoreans:—(6) *Met.*, i, 5, 986^a 1; xiv, 3, 1090^a 22; xiii, 6, 1080^b 2 and 16; xiii, 8, 1083^b 11; xiv, 3, 1090^a 32; i, 5, 986^a 1; i, 8, 990^a 21; xiii, 6, 1080^b 18; xiv, 3, 1091^a 18; xiii, 6, 1080^b 16; xiv, 3, 1090^a 20; i, 5, 987^a 15; *de Cœlo*, iv, 1, 300^a 15. (7) *Phys.*, iii, 4, 203^a 4; iii, 5, 204^a 20; *Met.*, i, 5, 987^a 15; iii, 1, 996^a 6; iii, 4, 1001^a 9; x, 2, 1053^b 12. (8) *Phys.*, iv, 6, 213^b 22 sqq.; *Met.*, xiv, 3, 1091^a 13; *de Part. An.*, ii, 10, 656^b 15; *de An.*, ii, 10, 419^b 34; *Met.*, i, 3, 984^a 7; i, 5, 986^a 25. (9) Arist., *Phys.*, v, 3, 227^a 27; *Met.*, xiii, 6, 1080^b 18 sqq.; 1083^b 8; *de Cœlo*, iii, 1, 300^a 16. (10) Burnet, *E.G.P.*, p. 276 sqq.; Zeller, *Pre-Socratic Philosophy*, vol. i, p. 407 sqq. (11) Gomperz, *Greek Thinkers*, vol. i, p. 105. (12) Burnet, *Greek Philosophy*, p. 90; *E.G.P.*, p. 99. (13) Burnet, *E.G.P.*, p. 307.

Heracleitus:—(14) Plato, *Tht*, 152^e 1; *Crat.*, 401^d 5; 402^a 8; Arist., *Top.*, i, 11, 104^b 22; *de Cœlo*, iii, 1, 298^b 30; *Phys.*, viii, 3, 253^b 2. (15) Bywater, *Heracl. Eph. Reliquiæ*, frag. 77. (16) Frag. 78. (17) Frag. 81. (18) Frag. 32. (19) Frag. 25. (20) Frag. 41-42. (21) Frags. 20 and 28. (22) Frag. 22. (23) Frags. 21, 23, 25. (24) Diogenes, ix, 7. (25) Frags. 21 and 23. (26) Arist., *de An.*, i, 2, 405^a 25. (27) Frags. 74-76. (28) Frags. 73 and 68. (29) Frag. 45. (30) Frag. 46. (31) Frag. 44. (32) Frag. 43. (33) Frag. 69. (34) Burnet, *E.G.P.*, 166-167. (35) Frag. 20. (36) Frag. 29. (37) Frag. 103. (38) Frag. 101. (39) Frag. 67. (40) Cf. Burnet, *E.G.P.*, 156. (41) Baeumker, *Das Problem der Materie*, p. 23 sqq.; Zeller, *Pre-Socratic Phil.*, vol. ii, p. 30 sqq.; Burnet, *E.G.P.*, p. 165. (42) *Met.*, iv, 3, 1005^b 23; iv, 7, 1012^a 25; xi, 5, 1062^a 31; xi, 6, 1063^b 24; *Top.*, viii, 5, 155^b 30; *Phys.*, i, 2, 185^b 19. (43) *Vorlesungen über d. Gesch. d. Phil.*, i, 305; *Logik*, i, 80.

The Eleatics:—(44) Frag. 6. (45) Frag. 5. (46) Frag. 8. (47) It is customary to throw this argument into the following form: what-is must come either from what-is or from what-is-not. The existence of the first horn of this dilemma in the original text is doubtful. Cf. Diels, *Vors.*, frag. 8, line 12. (48) Parmenides gives an account also of the "opinions of mortals" regarding the origin of the world of experience: but he says before beginning this account—"at this point I cease trustworthy discourse and the thought about truth," frag. 8, line 50. Cf. Burnet, *E.G.P.*, p. 182. (49) Simplicius, *Phys.*, i, p. 139, 7 sqq., and p. 141, 1 sqq. (50) Simpl., *Phys.*, i, p. 140,

28 sqq. (51) Simpl., *Phys.*, iv, p. 562, 3 sqq.; Arist., *Phys.*, iv, 1, 209^a 23, and iv, 3, 210^b 22. (52) Simpl., *Phys.*, vii, p. 255. (53) Arist., *Top.*, viii, 8, 160^b 8; *Phys.*, vi, 9, 239^b 5-33; *Phys.*, vi, 2, 233^a 11 and 21. (54) Diels, *Vors.*, frags. 3, 5, 6. (55) Frag. 8.

Empedocles:—(56) Frags. 11, 12. (57) Frag. 14. (58) Frag. 6. (59) Empedocles meant by air atmospheric air as distinct from empty space on the one hand and from rarified mist or vapour on the other: a new point of view at this date; cf. Burnet, *E.G.P.*, p. 229. (60) Earth was always in popular thought one of the primary bodies: Arist., *Met.*, i, 8, 989^a 5. (61) Frag. 9. (62) Frag. 17. (63) Frag. 89. (64) Frag. 17. (65) Frag. 23. (66) Arist., *de Gen. Corr.*, i, 8, 324^b 34. (67) Frag. 91·

Anaxagoras:—(68) Frag. 17. (69) Arist., *Phys.*, iv, 6, 213^a 22. (70) Frag. 10; *Dox.*, p. 279. (71) Frags. 1, 4. (72) Frag. 6. (73) Arist., *Met.*, i, 3, 984^b 15. (74) Frags. 11-14. (75) Arist., *Met.*, i, 4, 985^a 18; Plato, *Phd.*, 97^b 8. (76) Frags. 11, 8. (77) Frag. 12. (78) Frag. 6. (79) Frag. 3.

The Atomists:—(80) Burnet, *E.G.P.*, p. 330 sqq.; Baeumker, *Das Problem d. M.*, p. 79. (81) *de Gen. Corr.*, i, 8, 324^b 35; *Phys.*, i, 3, 187^a 1; *de Cælo*, iii, 4, 303^a 8. (82) Arist., *de Cælo*, i, 7, 275^b 32; *Phys.*, iii, 4, 203^a 34. (83) Arist., *Met.*, i, 4, 985^b 13 sqq.; viii, 2, 1042^b 12 sqq.; *Phys.*, i, 5; iii, 4, 203^a 19; *de Gen. Corr.*, i, 1, 314^a 21; 2, 315^b 33; 9, 327^a 18; 2, 315^b 9; 8, 325^b 27; 8, 325^a 30; *de Cælo*, iii, 4, 303^a 5 sqq.; *Phys.*, iii, 4, 203^a 33; *de Cælo*, iv, 2, 308^b 35. (84) Democritus, frag. 125. (85) The point at issue is whether the atomists held weight to be an original quality of the atoms: cf. Zeller, *Pre-Socratic Phil.*, vol. ii, pp. 226-241; Burnet, *E.G.P.*, p. 340 sqq. (86) Aet., i, 25, 4 (*Dox.*, p. 321).

Plato:—(87) *Tim.*, 29. (88) *Tim.*, 31-32. (89) *Tim.*, 48-49. (90) *Tim.*, 49-50. (91) Arist., *Phys.*, iii, 4, 203^a 15; iii, 6, 306^b 27; iv, 2, 209^b 33; i, 9, 192^a 11; *Met.*, i, 6, 987^b 20; i, 7, 988^a 25; iii, 3, 998^b 10. (92) *Phys.*, iii, 4, 203^a 3; i, 9; iv., 2, 209^b; *Met.*, i, 7, 988^a 25. (93) Zeller, *Plato*, p. 293 sqq.; Burnet, *Greek Philosophy*, p. 343 sqq.; Baeumker, *Das Problem d. Mat.*, p. 151 sqq. (94) *Tim.*, 48-52. (95) *Tim.*, 53-57. (96) *Tim.*, 52, 56, 57, 62. (97) Cf. Zeller, *Plato*, p. 320 sqq.; Burnet, *Greek Philosophy*, p. 312 sqq.; Baeumker, *Das Problem*, etc., p. 189 sqq.

CHAPTER II.

(1) *Met.*, i, 1, 981^b 28; iii, 1, 1003^a 26; i, 3, 984^a 25; i, 3, 984^b 11; i, 3, 984^a 16; vi, 1, 1025^b 3; vii, 3, 1029^a 1; *de Gen. Corr.*, ii, 9, 335^a 29; ii, 9, 335^b 29; ii, 9, 336^a 1; 335^a 33; 335^b 1; 335^a 30; 333^b 7; *Phys.*, ii, 8, 198^b 36; 199^a 1; 199, 18; 199^b 7.

Aristotle on the Milesians:—(2) *Met.*, i, 8, 988^b 23; iv, 5, 1009^a 36; i, 7, 988^a 34; i, 8, 988^b 28; i, 8, 988^b 26; *de Gen. Corr.*, ii, 9, 335^b 32; 335^b 24; ii, 1, 329^a 8; *de Cælo*, iii, 5, 304^b 11; i, 3, 270^a 14; *de Gen. An.*, v, 1, 778^b 7; *Phys.*, i, 7, 190^a 13; iii, 5, 205^a 4. (3) *Met.*, xii, 2, 1069^b 20; i, 7, 988^a 30; i, 8, 989^a 14; *Phys.*, i, 4, 203^a 16; 205^a 25; i, 4, 187^a 12; iii, 5, 204^b, 22; *de Cælo*, iii, 3, 302^a 15; 303^b 10; *de Gen. Corr.*, ii, 5, 332^a 20; ii, 1, 328^b 35.

Aristotle on the Pythagoreans:—(4) *Met.*, i, 8, 989^b 29 sqq.; xiii, 8, 1083^b 8; i, 8, 990^a 12; iii, 4, 1001^b 17; xiv, 3, 1090^a 30; 1092^b 15; 1080^b 16; 1091^a 13. (5) *Met.*, 1092^b 24. (6) 1092^b 18-30. (7) 1093^a 251. (8) 987^a 23. (9) 990^a 18. (10) 986^a 5.

Aristotle on Heracleitus:—(11) *Met.*, 984^a 7; 987^a 23. (12) *Met.*, iv, 5, 1010^a 15; *Phys.*, viii, 3, 253^b 9. (13) *Met.*, 1005^b 25. (14) *Met.*, 1062^a 31. (15) *Met.*, 1012^a 24; cf. Chapter i, note (42).

Aristotle on the Eleatics:—(16) *Phys.*, i, 2, 185^a 20; 187^a 3; *Met.*, iii, 4, 1001^b 7. (17) *Phys.*, i, 8; *Met.*, xiv, 2, 1089^a 26. (18) *Phys.*, i, 3, 187^a 1; iv, 3, 210^{b}22; vii, 5, 250^a 19; vi, 9; vi, 2, 233^a 21. (19) *Phys.*, i, 2, 185^b 19. (20) *Phys.*, i, 3, 186^a 5; i, 2, 184^b 25; *Met.*, i, 5, 986^b 10; *de Cælo*, iii, 1, 298^b 14; *de Gen. Corr.*, i, 8, 325^a 17.

Aristotle on Empedocles :—(21) *Met.*, i, 8, 989a 22; *de Gen. Corr.*, ii, 1, 329b; 7, 334a 18; i, 1, 314b 10; i, 1, 315a 3; i, 8, 325b 16; *de Cœlo*, iii, 7, 420. (22) *de Gen. Corr.*, i, 2, 329a 3; 325b 1 sqq.; 314a 10; 315a 3; *de Cœlo*, 390a 9. (23) *Met.*, i, 4, 985a 25; iii, 4, 1000b 12; *Phys.*, viii, 1, 252a 4; 251b 28; *de Gen. Corr.*, ii, 6, 333b 2; *de Cœlo*, i, 10, 280a 11; *de Part. An.*, i, 1, 640a 19.

Aristotle on Anaxagoras :—(24) *Phys.*, i, 4, 187b 7; iii, 4, 203a 19; iii, 5, 205b 1; iv, 6, 213a 22; *de Cœlo*, iii, 4; 302b 14; iv, 2, 309a 19; *de Gen. Corr.*, i, 1; i, 10, 327b 19; *Met.*, i, 8, 989a 30; *Phys.*, viii, 252a 10. (25) *Met.*, i, 8, 989a 30; *Phys.*, viii, 5, 256b 24; *de An.*, i, 2, 405a 13; 405b 19; iii, 4, 429a 18; *Met.*, i, 3, 984b 20; xii, 10, 1075b 8; xiv, 4, 1091b 10; i, 4, 985a 18; iii, 7, 988b 6.

Aristotle on the Atomists :—(26) *de Gen. Corr.*, i, 2, 315b 1. (27) *Phys.*, iv, 7, 214a 26-216a 27; *Phys.*, iv, c. 6-10; *de Cœlo*, iv, 2; *Phys.*, iv, 8, 214b 28; *de Cœlo*, i, 7, 275b 29; 277a 33; 294b 30; 300b 8; 279a 11. (28) Aristotle was mistaken in denying that all bodies fall with equal rapidity in the void: it must be remembered, however, that his opponents had no proof of this fact—its experimental verification being altogether beyond the reach of Greek science. (29) *Phys.*, 216a 27. (30) *de Gen. Corr.*, i, 2, 317a 1; 325b 27; 315b 9; 314a 21; *Phys.*, vi, 1, 231a 20; i, 4, 187b 22; viii, 6, 259a 8; iii, 4, 203a 19; iii, 5, 204a; iii, 6; *de Cœlo*, iii, 4, 303a 20; 303a 17; 303a 29; 303b 4; 306b 9; *de Gen. Corr.*, i, 8, 326a 1-326b 2. (31) *de Cœlo*, iv, 2, 310a 7; 312b 20; 308a 21; 309b 27; 308b 35; 306b 29; 308a 34; 274b 8; 276b 6; *Phys.*, iv, 8, 214b 28; 216a 13; *de Gen. Corr.*, i, 8, 326a 3. (32) *de Cœlo*, iii, 7; 305b 28; 306a 30; 305b 1; 305a 16; 305b 20; 303a 24; *de Gen. Corr.*, i, 1, 314b 10; 327a 14; 327a 22; 334a 18; 326b 6; 327a 7; *Met.*, i, 8, 989a 22; i, 9, 991a 14; viii, 2, 1042b 16; *de Gen. Corr.*, i, 10; 327b 13; 328a 18; 327b 10; 328a 23; 328a 10; 328a 5; 327b 22. (33) Aristotle often couples Empedocles with the Atomists here. It is worth noting that Aristotle admits this theory about rain: his objection is to its incompleteness. *Meteor.*, i, 11, 347b 18; *de Somno*, 3, 457b 31; *de Part. An.*, ii, 7, 653a 2. (34) *de An. Gen.*, 789b 1. (35) *Phys.*, 198b 34-199a 7; 199a 8-15; *de Part. An.*, i, 1, 641b 12; *Phys.*, 199a 15-20; 199a 20-30; *Meteor.*, iv, 2, 379b 25; *de Part. An.*, 641a 25; 641b 32; *Polit.*, i, 2, 1252b 32; *de Gen. An.*, ii, 6, 742a 28; *de Gen. Corr.*, ii, 9, 335b 6; *de Cœlo*, ii, 8, 289b 26; 290a 31; 291b 13; *de Vita et M.*, 469a 28; *Eth. N.*, 1173a 4. (36) *Meteor.*, iv, 2; *de Cœlo*, 311a 1; *de An.*, ii, 4, 415a 26; *Phys.*, ii, 8, 199a 20; *de Part. An.*, i, 5, 645b 14; *de An.*, iii, 12 and 13; *Met.*, vii, 8, 1033b 29; 1034a 22; xii, 3, 1070a 4; *de An.*, ii, 1, 735a 3. (37) *de Vita et M.*, 469a 28; *de Part. An.*, ii, 14, 658a 23; iv, 10, 687a 15; *de Incess. An.*, ii, 704b 16; *de Gen. An.*, i, 5, 717a 15; *Met.*, v, 16, 1021b 12; 1055a 11; *Phys.*, iii, 6, 207a 8; *Met.*, v, 16, 1021b 15; xii, 7, 1072b 30; *Phys.*, vii, 3, 246a 13; *de Gen. Corr.*, ii, 10, 336b 27; *Met.*, xii, 10, 1075a 11; 1075b 33; 1078a 31; 1072b 32; 984b 11; *de Cœlo*, ii, 14, 296a 33; *de Part. An.*, i, 5, 645a 23; 639b 19. (38) It is of fundamental importance for the study of Aristotelianism to grasp the implication that primordial matter prevents final causes from obtaining complete mastery in the world of change.

Aristotle on Plato :—(39) *de Cœlo*, iii, 1, 299a 6; 300a 7; 306a 23; 305b 31; 306b 5; 306b 9; 306b 22; *de Gen. Corr.*, ii, 1, 329a 21. (40) *de Cœlo*, iii, 1, 299a 25; 299b 31; 308b 3; 312b 20; 306a 1; 306a 20; 299b 23. (41) *de Cœlo*, 306b 29 sqq. (42) Plato's view of the scientific worthlessness of Cosmology, arising out of his theory of knowledge, is dealt with in that portion of the fourth chapter which expounds Aristotle's criticism of the Theory of Ideas.

CHAPTER III.

Theory of Scientific Proof :—(1) For a textual defence of this view as outlined consult Joseph, *Introduction to Logic*, p. 350 sqq.; cf. Notes to Introduction, no. (14). (2) Zeller, *Aristotle*, pp. 243-245. (3) *de Gen. An.*, iii, 10, 760b 27; *Eth. Nic.*, vi, 2, 1143b 13; *de Gen. Corr.*, i, 8, 325a; *de Cœlo*, ii, 12, 292a 15; ii, 5, 287-288; ii, 12, 291b 25. (4) Darwin, *Life and Letters*, iii, 252; also, despite an obvious anti-Aristotelian bias, Lewes, *Aristotle*, pp. 154, 155. (5) *Hist. An.*, vi, 10, 565b; *Hist. An.*, ii, 3, 501b 19; *Hist. An.*, v, 5, 541a 26; *de Gen. An.*, iii, 1, 751a 13; *Hist. An.*, iii, 12, 519a 3; *de Insomniis*, 2, 459b 27. (6) Burnet, *E.G.P.*, p. 296 sqq.; Zeller, *Plato*, 379-381; Taylor, *Plato*, p. 145. (7) *Met.*, xiv., 3, 1090b 39.

The Terrestrial and Celestial Universe :—(8) *de Cœlo*, i, 3, 270^b 5; *Meteor.*, i, 3, 339^b 21. (9) *de Cœlo*, i, 2, 268^b 14; i, 9, 279^b 2; ii, 6, 288^a 34; i, 3, 269^b 18; i, 3, 270^a 13; ii, 12, 292^b 17. (10) *Meteor.*, i, 3, 339^b 13; 340^a 18. (11) *de Cœlo*, i, 3; and practically all book iv. (12) *de Gen. Corr.*, ii, 2, 329^b 7-34; 330^a 24; *Meteor.*, iv, 1; *Meteor.*, iv, 5, 382^a 27; 10, 388^a 21; 11, 389^a 29; *de Gen. Corr.*, ii, 3, 331^a. (13) *de Gen. Corr.*, ii, 7 and 8.

The Structure of the Heavens :—(14) Cf. Zeller, *Aristotle*, vol. i, p. 492. (15) *de Cœlo*, ii, 8, 289^b 1-34; 291^a 7-22; 290^a 25; 291^b 14. (16) *de Cœlo*, ii, 12, 292^b 31; *Met.*, xii, 8, 1073^a 28; 1073^b 17. (17) *Met.*, xii, 8, 1074^a 1. (18) *Met.*, xii, 8, 1073^a 26; *de Cœlo*, ii, 1, 284^a 27; *Met.*, xii, 8, 1074^a 14. (19) *Meteor.*, i, 3, 340^b 10 and 341^a 2; *de Cœlo*, ii, 4, 287^a 15. (20) The view that Eudoxus and Calippus propounded the sphere-theory simply as a mathematical hypothesis and that Aristotle converted this mathematical hypothesis into a physical fact, and thereby grossly misunderstood it, is doubtful. Cf. Gomperz, *Greek Thinkers*, vol. iv, p. 230-233. (21) *de Cœlo*, ii, 12; iii, 5; ii, 1; i, 9, 279^a 10. (22) *de Cœlo*, 288^a 14; 289^a 4. (23) *Phys.*, ii, 4, 196^a 33; *Met.*, xii, 8, 1074^a 17; *de Cœlo*, ii, 12, 292^b 32; 3, 286^a 11.

Interaction of Terrestrial and Celestial Bodies :—(24) *Meteor.*, i, 2, 339^a 21; i, 3, 340^a 14. (25) *Meteor.*, iv, 1; iv, 4; iv, 5; iv, 10; iv, 11. (26) *de Cœlo*, ii, 7, 289^a 14; *Meteor.*, i, 3, 340^b 6. (27) *de Gen. Corr.*, ii, 10, 336^a 23; *Meteor.*, i, 9, 346^b 20; ii, 2, 354^b 26; *de Gen. Corr.*, 336^b 1; *Met.*, xii, 8, 1073^b 17. (28) *de Gen. An.*, iv, 10, 777^b 16. (29) *de Gen. Corr.*, ii, 10, 337^a 7. (30) *de Gen. Corr.*, ii, 10, 336^b 9 and 26; 337^a 1; 338^b 3; *Meteor.*, first three books *passim*.

The Shape of the Universe :—(31) *de Cœlo*, ii, 14, 297^a 6; 293^b 34; 297^b 23; 296^a 27; 296^b 25; 297^a 21; 296^a 34. (32) *de Cœlo*, ii, 4, 287^b 1; *Meteor.*, ii, 2, 355^a 35; 355^b 15; 356^a 33. (33) *Meteor.*, i, 3, 340^b 19; 341^a 2; 4, 341^b 6; 7, 344^b 8; 8, 345^b 3; ii, 2, 354^b 4; *de Cœlo*, ii, 4, 287^a 30. (34) *de Cœlo*, ii, 4, 287^a 30; 287^a 11; 287^b 14; 278^a 25; 279^a 7.

The Universe as a Whole :—(35) *de Cœlo*, i, 9, 278^a 25; 279^a 7; i, 8, 276^a 18; 276^a 30; 277^a 3; 277^b 9. (36) *de Cœlo*, i, 8; i, 9, 278^b 21; 279^a 11. (37) *de Cœlo*, i, 8, 277^b 9; *Met.*, xii, 8, 1074^a 31. (38) *de Cœlo*, i, 9. (39) *de Cœlo*, i, 3, 270^a 11; i, 9, 279^a 25; ii, 12, 292^b 17; i, 4, 271^a 20; i, 9, 277^b; *Met.*, i, 12, 1074^a 35. (40) *de Cœlo*, i, 3, 269^b 29. (41) *de Cœlo*, i, 3, 270^a 12; ii, 6, 288^a 22-34; 288^b 1; ii, 1, 284^a 13. (42) *de Cœlo*, i, 10, 279^b 20; 280^a 21; *de Gen. Corr.*, ii, 10, 336^a 15; 336^b 27.

CHAPTER IV.

Proof of the Possibility of Change :—(1) *Met.*, ii, 4, 999^b 6; x, 6, 1062^b 25; *Phys.*, i, 4, 187^a 28, 34; *de Gen. Corr.*, i, 3, 317^b 30. (2) *Phys.*, i, 5, 188^a 19-26; 188^a 31^b 26; 188^b 27-30; 188^b 33-35; iii, 5, 205^a 6; *Met.*, iv, 2, 1004^b 31-33; xii, i, 1069^b 3; xii, 10, 1075^a 28; xiv, 1, 1087^a 29; *de Cœlo*, iv, 3, 310^a 25; *de Gen. An.*, iv, 1, 766^a 13. (3) *Phys.*, i, 6, 189^a 21-27; i, 7, 190^b 33; i, 5, 188^a 30; v, 1, 224^b 4; *de Gen. Corr.*, i, 1, 314^b 23; i, 6, 322^b 16; ii, 1, 329^b 2; *Met.*, xii, 1, 1069^b 6; xii, 10, 1075^a 30. (4) *Phys.*, i, 7, 189^b 32 sqq.; *Met.*, xii, 2, 1069^b 7; vii, 7, 1033^a 5; *de Gen. Corr.*, i, 7, 324^a 15; *de Gen. An.*, i, 18, 724^b 2; *Cat.*, 10, 13^a 18. (5) *Phys.*, i, 7, 189^b 30; 190^b 13; 190^b 10-191^a 15; i, 8, 191^b 15; i, 9, 191^b 35; i, 9, 192^a 1 sqq.; i, 3, 187^a 5; i, 7, 190^b 23; 190^b 27; *de Gen. Corr.*, i, 7, 324^a 15; *Met.*, xii, 2, 1069^b 33; xii, 4, 1070^b 18; xii, 5, 1071^a 9. (6) *Phys.*, i, 7, 190^a 31 sqq.; 190^b 17. (7) *Phys.*, i, 7, 191^a 10. (8) *Phys.*, i, 8, 191^b 27; 191^a 23; *de Gen. Corr.*, i, 3, 317^b 23; ii, 9, 335^b 29; *Met.*, v, 12, 1019^b 22; ix, 1, 1046^a 69; v, 12, 1019^a 15 sqq.; 1046^a 9-13; 1017^b 1; 1045^b 33; 1089^a 28; 1045^a 23; 1050^b 2 sqq.; 1071^a 8-10; 1069^b 15 sqq.; 1009^a 32; *de An.*, ii, 1, 412^a 9; 402^a 26; 414^a 16. (9) *Phys.*, i, 8, 191^a 23 sqq.; i, 8, 191^b 27. (10) The Aristotelian doctrine of potential being has often been caricatured: partly owing to the malice of enemies, partly owing to the folly of friends. But Aristotle's explicit teaching on the strict meaning of potential being forecloses all attempts at satire. Potential being exists for him only when there exists in nature an active cause capable here and now, all things considered, of producing some new reality. A sick man is potentially healthy only if either the doctor or nature or both can cure

him and are on the point of beginning the process of healing : if, for any reason whatsoever, these efficient causes of healing are not on the point of starting a genuine cure, the invalid ceases to be potentially healthy. Another example of Aristotle's is based on earth, brass and statue : earth became brass and brass became a statue. Is earth potentially a statue ? No, for it must first change to brass. His third example is the most striking. Earth, he argues, can become male sperm. Is earth, then, potentially a man ? Not at all. Is even male sperm potentially a man ? Again, certainly not. The potential being of man does not arise until this sperm has undergone " a change in a foreign medium " : in other words the fertilised ovum, and it alone, is potentially a man. In short, what is never to be actual cannot be called potential ; and even what is to be actual cannot be called potential until it is on the brink of becoming actualised. *Met.*, ix, 7.

Facts and Factors of Accidental Change :—(11) *Met.*, xii, 2, 1069b 9-13 ; viii, 1, 1042a 32 ; vii, 9, 1034b 2 ; xi, 11, 1067b 12 ; 1067b 25 ; 1067b 36 ; 1068a 11 ; 1068b 15 ; xii, 2, 1069b 9 ; xiv, 1, 1088b 31 ; 1088b 1 ; *Phys.*, v, 1, 225a 3 ; v, 1, 225a 25 ; 225b 32 ; 225b 1 ; 200b 32 ; 225b 13 ; 226a 23 ; 226a 26 ; i, 7. 190a 31 ; *de Gen. Corr.*, i, 1, 319b 30 ; i, 4, 320a 2 ; etc., etc. (12) *Phys.*, i, 2, 185a 15 ; ii, 1, 193a 3 ; viii, 3, 253a 24 ; *Met.*, i, 5, 986b 31. (13) This part of the Aristotelian teaching is the main topic of Chapter viii. (14) *Met.*, i, 4, 985b 10 ; iii, 5, 1002a 22 ; v, 7, 1017b 7 ; v, 2, 1013a 25 ; v, 4, 1014b 29 ; vii, 10, 1035a 13 ; ix, 7, 1049a 18 ; ix, 7, 1049a 23 ; v, 2, 1013a 25 ; 4, 1014b 29 ; vii, 3, 1029a 4 ; 10, 1035a 6 ; viii, 2, 1043a 8 ; *Phys.*, i, 7, 190b 6 ; 191a 9 ; ii, 3, 194b 25 ; 195a 6 ; 195b 8 ; iii, 6, 207a 28 ; i, 4, 188a 15 ; 7, 190b 8 ; ii, 9, 200a 26 ; i, 7. 191a 9 ; ii, 1, 193a 14 ; i, 7, 190b 17 ; ii, 3, 194b 25 ; *de Part. An.*, i, 5, 645a 34 ; ii, 1, 646a 27 ; i, 1, 640b 23 ; *de Gen. An.*, i, 21, 729b 17 ; ii, 6, 743a 25. (15) *Phys.*, v, 1, 225a 20 ; *Met.*, xi, 11, 1067b 31 ; *Phys.*, ii, 1, 192b 14 ; v, 1, 225b 7 ; v, 2, 226a 24 ; vii, 2, 243a 6 ; viii, 7, 260a 26 ; *de Cœlo*, iv, 3, 310a 23 ; *de An.*, i, 3, 406a 12 ; *Met.*, xi, 12, 1068a 9 ; Aristotle is not always consistent in this verbal usage :—*Phys.*, iv, 10, 218b 19 ; iii, 1, 200b 32 ; 201a 11 ; viii, 7, 261a 33 ; *de Cœlo*, i, 2, 315a 26 ; etc. (16) *Met.*, vii, 13, 1038b 5 ; ix, 7, 1049a 28 ; *de Gen. Corr.*, 324a 15-19.

Facts and Factors of Substantial Change :—(17) *de Gen. Corr.*, i, 2, 315b 15 ; i, 3, 319a 10 ; ii, 4, 331a 12 ; i, 3, 318a 13. (18) *de Gen. Corr.*, i, 10, 327b 31 sqq. ; ii, 7, 334a 26 ; i, 10, 328a 3 sqq. ; ii, 7, 334b 28 ; ii, 7, 334b 2 ; 334b 8 ; i, 10, 327b 22 ; *de Hist. An.*, i, 1, 486a 5 ; *de Part. An.*, ii, 1, 647a 2 ; ii, 10, 655b 37 ; *de Ann.*, ii, 1, 412a 27. (19) *De Gen. Corr.*, i, 9, 327b 10 ; i, 13, 328a 23 sqq. (20) Cf. the references in Notes to Chapter ii., no. (32). (21) This medieval usage of the *term* " primordial matter " is not found in Aristotle's text. So far as I know, there are but two passages that seem to countenance it : *Met.*, viii, 4, 1044a 15 ; *de Gen. Corr.*, ii, 1, 329a 25. Ordinarily Aristotle uses this term, πρώτη ὕλη, in a totally different meaning. Primordial matter, in his usage, means that elementary body—or bodies—which is farthest distant in reference to any compound body : the four elements are the " primordial matter " of a statue. In contrast with this meaning of primordial matter, he speaks of a proximate matter, ἐσχάτη ὕλη : this proximate matter is matter that unites itself immediately and without requiring further change with a special form ; stone or brass is the proximate matter of a statue. (Cf. *Met.*, viii, 4, 1044b 2 ; 6, 1045b 18 ; ix, 7, 1049a 25 ; xii, 3, 1070a 20 ; *Meteor.*, iv, 2, 379b 20 ; *de An.*, ii, 2, 414a 26.) But Aristotle is not consistent in this usage : either phrase is sometimes employed in the opposite meaning. (Cf. *Met.*, v, 5, 1015a 7 ; xii, 2, 1069b 35.) These verbal inconsistencies do but illustrate, in regard to one pair of terms, the verbal confusion that reigns in our present Aristotelian text regarding many important words. Happily, the meaning is rarely obscured by such inconsistencies. (22) *de Gen. Corr.*, ii, 9, 335a 24 sqq. ; i, 5, 320a 13 ; *Met.*, ix, 8, 1050b 12 ; xii, 6, 1071b 18 ; xiv, 2, 1088b 19 ; vii, 7, 1032a 20 ; 17, 1041b 7 ; 15 ; 1039b 29.

Primordial Matter :—(23) *Met.*, vii, 3, 1029a 20 ; *Phys.*, i, 9, 192a 31 ; i, 7, 191a 10. (24) *Met.*, xiv, 1 ; xiv, 4, 1091b 30 ; xii, 10, 1075a 22 ; ix, 6, 1048a 30 ; 8, 1050a 21 ; vii, 3, 1029a 20 ; 11, 1037a 27 ; ix, 7, 1049a 24 ; iv, 4, 1007b 28 ; *Phys.*, i, 6, 189a 20 ; 9, 192a 16 ; iv, 9, 217a 22 ; i, 9, 192a 28 ; i, 7, 191a 7 ; iii, 1, 201a 29 ; iv, 2, 209b 9 ; *de Gen. Corr.*, i, 10, 328b 10 ; ii, 9, 335a 32 ; *de An.* ii, 1, 412a 6 ; 2, 414a 9 ; *de Cœlo*, iii, 8, 306b 17. (25) Baeumker,

Das Problem, etc., p. 247 sqq. ; Hertling, *Materie und Form und die Definition der Seele bei Aristoteles*, Bonn (1871), p. 87 sqq. (26) *Met.*, viii, 2, 1042a 23 ; i, 4, 985b 10 ; 9, 992b 1 ; viii, 1, 1042a 13 ; vii, 3, 1029a 23 ; viii, 4, 1044a 15 ; ix, 7, 1049a 35 ; 8, 1050b 27 ; xiii, 2, 1077a 35 ; viii, 1, 1042a 26 ; 2, 1042b 9 ; *de Gen. Corr.*, i, 5, 321b 19 ; i, 3, 317b 23 ; *Phys.*, ii, 2, 194a 12 ; 8, 199a 30 ; i, 7, 191a 8 ; *de Gen. Corr.*, i, 6, 322b 19 ; *Met.*, v, 4, 1015a 13. (27) *de Cœlo*, iii, 6, 305a 22 ; *de Gen. Corr.*, i, 5, 320b 23 ; ii, 1, 329a 33 ; ii, 1, 329a 8 ; 2, 329b 17 sqq. ; *de An.*, ii, 11, 423b 28 ; *de Part. An.*, ii, 1, 646a 16 ; 647a 18 ; *de Cœlo*, iii, 6, 305a 22 sqq. (28) *de Gen. Corr.*, i, 3, 318a 23 ; i, 3, 319a 5 sqq. ; i, 5, 320b 16 ; ii, 1, 329a 10 sqq. ; *Phys.*, iii, 8, 208a 8 ; iv, 2, 209b 22 ; 4, 212a 1 ; 7, 214a 14 ; ii, 1, 193b 3 ; *Met.*, vii, 3, 1029a 27 ; 10, 1035a 8 ; 11, 1036b 23 ; 12, 1038a 5. (29) *de Gen. Corr.*, i, 7, 324b 18 ; ii, 9, 335b 29 ; i, 7, 324b 5 ; 324a 34 ; i, 10, 328a 19 ; ii, 9, 335b 24 ; *Met.*, i, 3, 984a 21 ; ii, 6, 1071b 29 ; *de Gen. An.*, ii, 6, 743a 26. A number of texts seem at first sight to deny the passivity of primordial matter. The solution of this difficulty is that these texts do not refer to primordial matter. "Matter" as a physical reality has for Aristotle at least three meanings : (*a*) primordial matter or the "matter" of substantial change ; (*b*) an existing substance or the "matter" of accidental change ; (*c*) the patient as opposed to the agent—a slight variant of (*b*) for the purpose of treating causal problems. Whenever there is question of active power of force in "matter," the reference is to either (*b*) or (*c*). Cf. Baeumker, *Das Problem*, etc., p. 266 sqq. ; Mansion, *Introduction a la Physique Aristotélicienne*, pp. 123 sqq. ; Werner, *Aristotle et l'Idealisme Platonicien*, pp. 91 sqq. ; Piat, *Aristote*, pp. 35 sqq. (30) *de Gen. Corr.*, i, 3, 319a 33 ; 5, 320b 12 ; ii, 4, 331a 12 sqq. ; i, 3, 318a 13 ; *Met.*, viii, 4, 1044a 15 ; *Phys.*, iv, 9, 217a 25 ; *de Cœlo*, iii, 1, 298b 9. (31) *Phys.*, iii, 6, 206b 14 ; iii, 4, 203b 18 ; 8, 208a 8 ; *de Gen. Corr.*, ii, 10, 337a 5 ; *Anal. Post.*, ii, 12, 95b 38. (32) *Phys.*, i, 9, 192a 25 sqq. ; *Met.*, xii, 3, 1069b 35 ; vii, 8, 1033a 28 ; viii, 1, 1042a 26. (33) *de Gen. Corr.*, ii, 5, 332a 35 ; *Phys.*, iii, 6, 207a 25 ; i, 7, 191a 7 ; *Met.*, vii, 10, 1036a 8 ; 1035a 8 ; 15, 1039b 27. (34) *Phys.*, i, 9, 192a 17 ; ii, 1, 192b 18 ; *Met.*, xii, 7, 1072b 3 ; v, 23, 1023a 8 ; v, 5, 1015a 26 ; v, 23, 1023a 17 ; xii, 7, 1072b 12. (35) *Met.*, vii, 8, 1034a 5-8 (the first quotation) ; vii, 10, 1035b 33 ; 1036a 6 ; 1036a 28 ; 15, 1039b 23 ; viii, 1, 1042a 28 ; i, 6, 988a 3 ; xii, 5, 1071a 27 (the second quotation) ; x, 9, 1058a 34 sqq. Hertling's contention that the substantial form in Aristotle must be in itself an individualised reality is ably discussed by Zeller, *Aristotle and the Earlier Peripatetics*, vol. i, pp. 369 sqq. (36) *Met.*, xii, 3, 1070a 21 ; vii, 8, 1033a 28 ; *de An.*, ii, 4, 415a 25 sqq. ; *de Gen. An.*, ii, 1, 731b 31.

Substantial Form :—(37) *de An*, iii, 3, 427a 17 ; 428a 17 ; ii, 5, 417b 22 ; *Top.*, v, 2, 130b 15 ; 3, 131a 23 ; 4, 133b 29 ; 5, 134b 16 ; vi, 8, 146b 1 ; *An. post.*, i, 8, 75b 24 ; i, 2, 71b 15 ; 4, 73a 21 ; 6, 74b 6 ; 31, 87b 28 ; 18, 81b 6 ; i, 24, 86a 29 ; 31, 87b 37 ; 31, 87b 32 ; ii, 12, 96a 8 ; i, 8 ; 24, 85b 15 ; 24, 86a 4 ; *Met.*, iii, 4, 999b 4 ; vii, 15, 1039b 30 ; xii, 1, 1069b 3 ; vii, 10, 1036a 6 ; 15, 1040a 2 ; 1039b 27 ; xiii, 10, 1086b 33 ; 9, 1086o 5 ; i, 2, 982a ; iii, 4, 999a 28 ; 6, 1003a 14 ; xi, 1, 1095b 25 ; 2, 1060b 20. (38) *Met.*, i, 9, 990b 10-30. (39) *Met.*, i, 9, 991a 9-991b 7. (40) *Met.*, i, 9, 990b 1. (41) *Met.*, xiii, 9, 1086b 2 ; 4, 1078b 30 ; vii, 13, 1038b 11 ; iii, 4, 999b 34 ; v, 9, 1017b 35 ; 8, 1017b 13 ; vii, 3, 1028b 36 ; *de Interpret.*, 7, 17a 39 ; *Anal. Post.*, i, 4, 73b 26 ; 31, 87b 32 ; *Anal. Post.*, i, 11 ; i, 27, 43a 35 ; *de Part. An.*, i, 4, 644a 27 ; *Cat.*, c. 5. (42) *Met.*, vii, 6, 1031b 6 ; viii, 1, 1042a 29 ; iv, 4, 1007a 23 ; x, 9, 1058b 1 ; vii, 8, 1033b 14 ; 9, 1034b 8 ; viii, 3, 1043b 17 ; 5, 1044b 22 ; xii, 3, 1069b 35 ; 1070a 15 ; vii, 8, 1033a 34 ; xii, 3, 1070a 2 ; vii, 15, 1039b 20 ; vii, 9, 1034b 13 ; xii, 11, 1067b 9 ; *de Cœlo*, i, 9, 277b 30 sqq. ; *de Gen. Corr.*, ii, 9, 335b 7 ; 335b 35 ; *Phys.*, v, 1, 224b 4. (43) *de An.*, ii, 4, 415b 10 sqq. ; *de Part. An.*, i, 1, 641a 27 ; i, 5, 645b 14 ; *Phys.*, ii, 1, 193b 8 ; 2, 194b 13 ; 7, 198a 26 ; iii, 2, 202a 11 ; *de Gen. Corr.*, i, 5, 320b 20 ; ii, 6, 333b 7 ; *de Part. An.*, i, 1, 640a 25 ; ii, 1, 646a 33 ; *de Gen. An.*, ii, 1, 735a 21 ; *Met.*, vii, 7, 1032a 25 ; 8, 1033b 32 ; 9, 1034b 2 , xii, 3, 1070a 8 ; 4, 1070b 31 ; xiv, 5, 1092a 16 ; *Phys.*, i, 7, 190b 6 ; 191a 9 ; ii, 3, 194b 25 ; 195a 6 ; 195b 8 ; iii, 6, 207a 28 ; *Met.*, v, 2, 1013a 25 ; 1013b 27 ; 4, 1014b 29 ; vii, 3, 1029a 4 ; 10, 1035a 6 ; ix, 7, 1049a 18 ; and in numerous other texts of the *Phys.*, the *Met.*, the *de Part. An.* and the *de Gen. An.* (44) *de An.*, ii, 1, 412b 4. (45) *Phys.*, ii, 7, 198a 24 ; i, 7, 190b 17 ; ii, 8, 199a 30 ; ii, 9, 200a 14 ; *de An.*, ii,

4, 415b 7 ; i, 1, 403b 6 ; *Met.*, xii, 5, 1071a 18 ; viii, 4, 1044b 1 ; vi, 2, 1026b 13 ; 1032b 11 ; *de Gen. An.*, i, 1 ; ii, 1, 732a 3 ; 6, 742a 28 ; ii, 4, 740b 28 ; *de Part. An.*, i, 1, 639b 14 ; i, 1, 641a 25 ; i, 1, 640a 31 ; *de Gen. Corr.*, ii, 9, 335b 5 ; 335b 33 ; 35 ; i, 7, 324a 34 ; i, 7, 324b 15. (46) *Met.*, vii, 3, 1029a 5 ; 1029a 27 ; v, 4, 1015a 13 ; *Phys.*, i, 9, 192a 5 ; 192b 20 ; ii, 1, 193a 36 ; ii, 2, 194a 28 ; i, 9, 192a 16 ; *de Cœlo*, i, 2, 268b 16 ; iii, 5, 304b 13 ; *de Part. An.*, i, 1, 640b 28 ; 642a 17 ; *de Gen. Corr.*, ii, 9, 335b 34 ; *de Gen. An.*, ii, 1, 732a 3. (47) *Met.*, vii, *passim ;* v, 8, 1017b 21 ; vii, 4, 1030a 6 ; 1030b 26 ; v, 13, 1020a 18 ; vii, 6, 1031a 18 ; 1031b 2 ; 7, 1032b 2 ; 1032b 14 ; viii, 1, 1042a 18 ; viii, 3, 1043b 1 ; i, 3, 983a 27 ; viii, 4, 1044a 36 ; i, 10, 993a 17 ; iii, 2, 996b 8 ; vii, 7, 1034a 30 ; vii, 7, 1032a 15 ; *de Gen. Corr.*, ii, 9, 335b 6 ; *Phys.*, ii, 3, 194b 26 ; 7, 198a 16 ; ii, 1, 193a 31 ; 2, 194a 20 ; 194b 10 ; 194b 26 ; 200a 14 ; 200a 34 ; 200a 22 ; ii, 7, 198b 3 ; ii, 7, 189a 16 ; *de Cœlo*, i, 9, 277b 30 ; ii, 8, 289b 21 ; *de An.*, i, 1, 403b 2 ; ii, 2, 414a 9 ; *de Part. An.*, i, 1, 642a 17 ; 641a 25 ; 640b 28 ; iii, 2, 663b 23 ; iv, 5, 678a 34 ; i, 1, 642a 25 ; i, 1, 639b 26-640a 6 ; 640a 31 ; ii, 1, 646a 35-b28 ; *Post. Anal.*, ii, 11. 94a 21 ; *de Gen. An.*, i, 1, 715a 5 ; iv, 2, 767a 16 ; *Meteor.*, iv, 2, 379b 25 ; 379b 35 ; *de Somno*, 2, 455b 16 ; *Post. Anal.*, ii, 3, 90b 30 ; *Top.*, vii, 5, 154a 31 ; 4, 101b 21 ; 7, 103a 25 ; i, 5, etc., etc. Cf. Bonitz, *Index Arist.*, under these titles. (48) *Phys.*, iii, 7, 207a 35 ; i, 1, 193b 6 ; iv, 2, 209b 1 ; 4, 211b 10 ; *de An.*, ii, 1, 412a 9 ; ii, 2, 414a 9 ; *de Gen. Corr.*, i, 4, 320a 2 ; 10, 328b 11 ; *de Cœlo*, iv, 4, 312a 12 ; *Met.*, x, 4, 1055a 29 ; viii, 2, 1042b 9. (49) *Phys.*, iv, 2, 209b 23 ; *de Gen. Corr.*, i, 7, 324b 18-22. (50) *Met.*, iv, 4, 1007a 23 ; x, 9, 1058b 1. (51) *Phys.*, ii, 7, 198a 24 ; i, 7, 190b 17 ; *de An.*, ii, 4, 415b 7 ; *Met.*, xii, 5, 1071a 18 ; viii, 4, 1044b 1 ; *De Gen. An.*, ii, 1, 732a 3 ; ii, 6, 742a 28 ; *Met.*, ix, 6, 1048a 30 ; 8, 1050a 21 ; *Phys.*, i, 7, 191a 7 ; iii, 1, 201a 29 ; ii, 3, 195a 8 ; *Met.*, ix, 8, 1049b ; vii, 9, 1034b 16. (52) *Phys.*, ii, 7, 198a 25 ; viii, 2, 252b 24 ; 8, 199a 30 ; *de An.*, ii, 4, 415b 7 ; ii, 1, 412a 15 ; *de Part. An.*, i, 1, 640b 22 sqq. ; 5, 645b 14 ; *de Gen. An.*, i, 1, 715a 4 ; ii, 4, 738b 26 ; *Met.*, vii, 8, 1033b 29 ; viii, 4, 1044a 36 ; 1044b 1 ; ix, 8, 1050a 8 ; *de Gen. Corr.*, ii, 9. (53) *Met.*, xii, 5, 1071a 27. (54) *Met.*, xii, 3, 1070a 23. (55) *Met.*, vii, 8, 1033b 14 ; 9, 1034b 8 ; viii, 3, 1043b 17 ; 5, 1044b 22 ; xii, 3, 1069b 35 ; 1070a 15 ; vii, 8, 1034a 8 ; xi, 9, 1058b 9 ; iii, 3, 998b 28 ; x, 8, 1058a 18 ; 9, 1058b 8 ; vii, 8, 1034a 5 ; ix, 7, 1049a 23 ; i, 6, 988a 1 ; *de Cœlo*, i, 9, 278a 18. (56) *Met.*, xii, 5, 1071a 27 ; 3, 1070a 21 ; *de An.*, ii, 4, 415a 25 ; *de Gen. Corr.*, ii, 1, 731b 31 ; *Met.*, vii, 8, 1033a 28 ; *de Gen. An.*, ii, 1, 731b 31. (57) *Met.*, vii, cc. 7, 8, 9 ; xii, cc. 3, 4 ; *Phys.*, i, c. 4. (58) Cf. Chapter ii, notes (37) and (38).

Substance and Attribute :—(59) *Phys.*, i, 9, 192a 13-25. (60) *Met.*, viii, 6, 1045b 17-20 ; *de An.*, ii, 1. (61) *Met.*, viii, 3, 1043b 4-23 ; cf. Bonitz, *Aristotelis Metaphysica*, pp. 367-368. (62) Aristotle extends the application of these concepts, matter and form—and their synonyms, potency and actuality —beyond the sphere of physical change. " Aristotle goes on to speak of (intelligible) matter which he finds, for example, in conceptions and in mathematical figures. To this belongs whatever, without being itself corporeal, stands to something else in the same relation as corporeal Matter (i.e. the Matter of bodies) stands to Form. Hence we see that not only does each of these notions denote a single existence or definite class of things, but they are used, though undoubtedly obtained in the first instance by abstraction from corporeal things, wheresoever a relation subsists analogous to that which they originally express. Thus in analysing conceptions into their two elements, Aristotle attributes to the genus the same significance as Matter while he identifies the specific difference with the Form. Similarly in the scheme of the universe, in physiology, in zoology, in psychology, the upper and the lower spheres and elements, the soul and body, the male and female, the Active and Passive Reason, stand to one another in the same relation as the Form and the Matter. The same is true, it need hardly be remarked, of Potency and Actuality. These also express a definite relation which may subsist between all possible kinds of objects, and which can best be explained by analogy. Aristotle applies them in precisely the same way as Matter and Form. He uses them, for instance, to elucidate the connexion between the genus and the specific differences, and in general to show the possibility of several properties belonging to one and the same thing. By them he explains the relation between the passive and the active understanding. It follows that one and the same

thing may be viewed in one aspect as Matter, in another as Form; as Potency in the first, as Actuality in the second. The elements, for instance, which contain the material of all other bodies, are Forms of the primitive Matter; the brass which supplies the material for a statue has its own peculiar Form as a specific metal. While the soul in general is viewed as the Form of the body, yet even in its own highest and most immaterial part a distinction is made between two elements which are related to one another as Form and Matter. Indeed, we shall find that everything except the 'eternal immaterial substances' contains some element of Matter, while on the other hand, as we already know, Matter never actually presents itself to us except as endowed with Form. We may therefore distinguish several stages in the development of Matter into Form. The first purely formless Matter lies at the foundation of all things: but it is also true that everything has its own peculiar and intimate Matter. Between these two lie all the material foundations through which the original Matter has to pass before it becomes the particular Matter with which the Form of the thing immediately unites itself. The same holds true of δύναμις. We ascribe potential knowledge not only to the man of learning when he is conceived as not actually engaged in scientific activity, but also to the learner, and even to man in general. But the sense in each case varies, and we have to distinguish between the degrees of proximity to ἐνέργεια. Nothing attains the realisation of that which it had at first the mere capacity to be, except by degrees: and in the universe at large there are an infinite number of intermediate stages between mere Potency or the first Matter, and complete Actuality, which is pure Form or God." Zeller, *Aristotle and the Earlier Peripatetics*, i, pp. 352-355, where all references are given. (63) *Met.*, v, 30, 1025ᵃ 30; 7, 1017ᵃ 12; iii, 1, 995ᵇ 18; 2, 997ᵃ 25; iv, 2, 1004ᵇ 5; vi, 1, 1025ᵇ 12; vii, 4, 1029ᵇ 13; *Anal. Post.*, i, 22, 83ᵇ 11; i, 4, 73ᵇ 5; i, 6, 75ᵃ 18; i, 7, 75ᵃ 42; *Phys.*, i, 3, 186ᵇ 18; ii, 2, 193ᵇ 26; 3, 195ᵇ 13; iii, 4, 203ᵇ 33; *de An.*, i, 1, 402ᵇ 16; cf. Joseph, *Introduction*, etc., pp. 61 sqq.; Zeller, *Aristotle*, etc., vol. i, pp. 223 sqq. (64) *Met.*, vi, 2, 1027ᵃ 13; vi, 3, 1027ᵇ 15; x, 9, 1058ᵃ 34; viii, 4, 1044ᵇ 12; *de Gen. An.*, v, 1, 778ᵃ 32 sqq.; 8, 789ᵇ 20; i, 18, 725ᵃ 4; *Phys.*, ii, 8, 198ᵇ 18; *de Part. An.*, iv, 2, 677ᵃ 15; iii, 2, 663ᵃ 6 sqq. (65) *de Gen. Corr.*, i, 5, 320ᵇ 16; 320ᵇ 22; 320ᵇ 32; *de An.*, ii, 11, 423ᵃ 21; *Phys.*, iv, 9, 217ᵃ 26. (66) *de Gen. Corr.*, i, 5, 322ᵃ 10-28; 321ᵃ 2-20; 321ᵇ 22-34; iv, 2, 335ᵃ 15; *Phys.*, iv, 2, 209ᵇ 8; *de An.*, ii, 4, 416ᵇ 11. (67) *Phys.*, iv, 9, 217ᵃ 31 sqq.; cf. Chapter viii—Density and Rarity. (68) *Met.*, viii, 6, 1045ᵃ 8-12; v, 6 *passim*; *Phys.*, v, 3, 227ᵃ 10 sqq.; vi, 1, 231ᵃ 20 sqq.; *de Gen. Corr.*, i, ix, 327ᵃ 18.

Post-Aristotelian Greek Theories of Matter:—For a detailed account of Aristotle's Greek successors in Cosmology consult: Baeumker, *Das Problem*, etc., p. 303 sqq.; Zeller, *Stoics, Epicureans and Sceptics*; Whittaker, *The Neo-Platonists.*

Palmieri (*Institutionæ Philosophicæ*, vol. ii, pp. 128 sqq.) contrasts two theories of hylemorphism: the "vague" and the "explicit." "Explicit" hylemorphism teaches that neither primordial matter nor substantial form is a complete substance and that material substance in the genuine sense arises only from the union of these distinct positive principles: and as a result of this false starting-point, it teaches all sorts of reprehensible doctrines about the nature and properties of primordial matter and substantial form. "Vague" hylemorphism teaches that "matter" and "form" are simply different aspects of actually existing bodies: that "matter" is a complete substance or a group of them and "form" the disposition and arrangement of them; and as a result of this valuable starting-point, it teaches conclusions which differ only verbally from those of modern dynamism and atomism. Having invented this distinction between "vague" and "explicit" hylemorphism, Palmieri proceeds to prove that, while the later Schoolmen certainly advocated "explicit" hylemorphism, Aristotle propounded nothing but "vague" hylemorphism. This is sheer mythology. At this stage of our inquiry, there can be no need of pointing out the chasm between this thesis and the text of Aristotle. The reader who wants a documented criticism of details may consult Fr. de San S.J. *Cosmologia* (pp. 164 sqq.). Palmieri makes his myth plausible by equivocation concerning a few texts, and by wholesale suppression of the majority of pertinent texts. He tells his readers that Aristotle speaks of primordial matter

as substance: he does not tell them that Aristotle makes perfectly clear the special meaning in this reference of substance, that he contrasts this meaning with the proper meaning of substance, and that he denies primordial matter to be substance in the proper sense. He tells his readers that Aristotle speaks only of "sensible subjects" as ceasing to persist during substantial change; he does not tell them that Aristotle denies the existence of material substances other than "sensible subjects," and proves the *incorporeality* of primordial matter. He tells his readers that Aristotle sometimes speaks of one and the same substance as "matter," as "form," and as a composite whole: he does not tell them that Aristotle acknowledges in the use of these terms "matter" and "form" a wide relativity based on the analogy of their respective rôles as factors of change. He tells his readers that Aristotle teaches there can be no generation of "form"; he does not tell them that Aristotle insists on the coming into existence of a new substantial form whenever generation of substance occurs, and on the passing out of existence of an already existing substantial form whenever corruption of substance occurs. In view of this manipulation of the Aristotelian text, it is clear that the only readers who can accept this thesis of Palmieri are those who never consult the text of Aristotle. The historical facts are: Aristotle fought "vague" hylemorphism tooth and nail—read his criticism of Empedocles and of Democritus; Aristotle exulted in "explicit" hylemorphism as the last word in Cosmology—read the positively indecent pæan of self-praise (*Met.*, xii, c. 10) which he chants over his discovery of primordial matter and substantial form. These historical facts are proclaimed by every authoritative commentator: ancient or modern, pro-Aristotelian or anti-Aristotelian. Aristotle's philosophy of matter may be true or false but there is no shirking the issue that part of his fame as a cosmologist stands or falls by his advocacy of what Palmieri styles "explicit" hylemorphism and his rejection of what Palmieri styles "vague" hylemorphism.

CHAPTER V.

THE noteworthy Realist writers among the Schoolmen from the thirteenth century onwards were: Alexander of Hales (+ 1245), St. Bonaventure (1221-1274), Roger Bacon (1214-1294), Albert the Great (1193-1280), St. Thomas (1225-1274), Giles of Rome (Aegidius) (1243-1316), Hervé (Hervaeus) of Nedellec (+ 1323), Henry of Ghent (+ 1293), Scotus (1266/74-1308), Francis of Mayron (+ 1327), Antony Andreas (+ 1320), John Canonicus (fl. 1320), John Bassolius (fl. 1320), Peter de Palude (+ 1342), Durandellus (+ 1380), Walter Burleigh (+ 1337), John Capreolus (1380-1444), Dominic of Flanders (+ 1500), John Gerson (1364-1429), Thomas of Strasburg (+ 1357), Denis the Carthusian (1402-1471), Soncinas (+ 1494), Cajetan (1469-1534), Francis a Sylvestris (Ferrariensis) (1474-1528), Javellus (1488-1550), Soto (1494-1528), John of St. Thomas (1589-1644), Vasquez (1551-1604), Toletus (1532-1596), Fonseca (1528-1599), Suarez (1548-1617), Cosmo Alemanni (1559-1634), Sylvester Maurus (1618-1687), Goudin (1639-1695), Claudius Frassen (1620-1711), Soares (fl. 1650), Aquirre (fl. 1670), Mastrius de Meldula (fl. 1698). Besides these individual authors, there were famous group-writers like the Complutenses, the Conimbricenses, the Salmanticenses, the Salisburgenses. Nor can an Irishman forget the Franciscan Commentators of the Lyons edition (1639) of Scotus: Lucas Waddingus, Waterfordiensis; Mauritius a Portu (an O'Fihilly, Archbishop of Tuam); Hugo Cavellus (a Caughwell, Archbishop of Armagh); Joannes Poncius, Corcagiensis; Antonius Hiquaeus, Tuomoniensis; Franciscus Lychetus, Brixiensis; Franciscus Pitigianus Arretinus.

The great medieval nominalist philosophers were: the Dominican Durandus of St. Pourcain, a Bishop (+ 1322); the Franciscan Peter d'Auriol, a Cardinal (+ 1321); William of Ockham (+ 1347); Gregory of Rimini (+ 1358); Peter d'Ailly, a Cardinal (+ 1420); Marsilius of Inghen (+ 1396), John Buridan (+ 1360); Albert of Saxony (+ 1390); Gabriel Biel (1430-1495).

Aristotle is generally quoted in these medieval chapters after the fashion of the School: in such quotations, l. stands for book, c. for chapter, t. for text.

The Commentaries of the Schoolmen on the *Four Books of the Sentences* of Peter Lombard (+ 1160) are also quoted after a medieval usage: thus, Scotus,

4, dist. (*or* d.) 12, q. 2 stands for, *Scotus on the fourth Book of the Sentences, twelfth distinction, second question.*

As the chapters on Medieval Cosmology in this volume are mainly an exposition of Thomistic Cosmology and the controversies consequent thereon, I wish to draw the reader's attention here to the value of the various works of St. Thomas that are quoted. Setting aside all the Commentaries on Scripture as extraneous to my purpose, the authentic treatises of St. Thomas are given in the official catalogue (1319) as follows: *Quatuor libri super Sententias ; Tres partes Summae ; De quaestionibus disputatis, partes tres ; Undecim quodlibet disputata ; Opus contra Gentiles—quatuor libri ; Super Dionysium De divinis nominibus ; Super Boëthium De hebdomadibus ; Super Boëthium De Trinitate ; De fide et spe ; Super primum Perihermenias ; Super librum Posteriorum ; Super librum Physicorum ; Super libros De Caelo tres ; Super librum De Generatione ; Super duos libros Metheororum ; Super secundum et tertium De Anima ; Super librum De Sensu et Sensato ; Super librum de Memoria et Reminiscentia ; Super librum De Causis ; Super Metaphysicam ; Super librum Ethicorum ; Super Politicam, libri quatuor.* The authentic opuscules of St. Thomas are given in the official catalogue as follows: *Contra impugnantes Dei cultum et religionem ; De operationibus occultis ; Item—in quibus potest homo licite uti judicio astrorum ; De principiis naturae ; De substantiis separatis ; De rationibus fidei ; De perfectione vitae spiritualis ; Contra doctrinam retrahentium a religione ; De sortibus ; De forma poenitentiae absolutionis sacramentalis ; Contra errores Graecorum ; Declaratio triginta sex quaestionum ; De regimine Iudaeorum ; Declaratio triginta trium quaestionum ; Declaratio sex quaestionum ; De ente et essentia ; De mixtione elementorum ; De motu cordis ; De unitate intellectus ; De aeternitate mundi ; Expositio circa Primam decretalem De Fide catholica et Summa Trinitate ; Expositio circa secundam Damnamus ; De articulis fidei et sacramentis Ecclesiae ; Brevis compilatio theologiae.* All these treatises and opuscules were written by St. Thomas. His *Lectura Super primum de Anima* has come to us in notes taken down by Raynaldus de Piperna from St. Thomas's oral lectures on that book. The other works generally ascribed to St. Thomas are of more or less doubtful authenticity. Some of these doubtfully authentic works are quoted in the notes to this volume, but it will be found that no view is attributed to St. Thomas except when found in one, or more, of the certainly authentic writings of the Saint. Cf. Mandonnet, *Des écrits authentiques de Saint Thomas d'Aquin, Revue Thomiste,* 1909, March-April, sqq.; De Wulf, *Histoire de la Philosophie Médiévale,* 1912, pp. 401-402.

The Proofs of Hylemorphism :—(1) St. Thos. 2, d. 30, q. 2, a. 2; *de Verit.*, q. 13, a. 3, 1m. (2) Aristotelian texts quoted in favour of this composition: 1 *de Cælo*, c. 9. tt. 93, 94, 95; 12 *Met.*, t. 22; 2 *de Gen.*, c. 9, t. 51; 8 *Met.*, t. 10. Texts quoted against it: 8 *Met.*, tt. 4, 12, 14; 9 *Met.*, t. 17; 12 *Met.*, t. 10. (3) St. Thomas, *S. Th.*, 1, q. 66, a. 2; 1 *de Cælo*, lect. 6; 8 *Phys.*, lect. 20; Capreolus, 2, dist. 12, q. 1; Socin., 12 *Met.*, q. 7; Javel, l. 8, q. 12; Soto, *Phys.*, q. 1; Scotus, 2, dist. 14, q. 1 (on theological grounds); Aegidius, 2, dist. 2; do., 1 part., *Hexam.*, c. 4; Ockham, in 2, q. 22; St. Bonaventure, 2, dist. a. 2, q. 1; Avicenna, l. 1 Suffic, c. 6; Conimbr., *de Cælo*, 1, c. 2, q. 4, a. 2; Aquirre, *de Cælo*, d. 63, s. 1. The remark of the Nominalist, Marsilius of Ingen (in iv, l. 2, q. 8) that the contrary opinion was common in his time, late fourteenth century, is difficult to reconcile with extant sources. Of the thirteen great writers of that century only four, three of whom including Marsilius himself are Nominalists, advocate that opinion. And in the seventeenth century, Pontius, whilst denying that reason supports the hylemorphic composition of the heavenly bodies, allows that the number and authority of the "*Doctores*" make it the more probable theory. *Cursus Phil.*, disp. 51, q. 1. (4) *de Cælo*, 1, lect. 6; *S. Th.*, 1, q. 66, a. 2; *Phys.*, 1, 8, lect. 21; *de Angelis*, c. 8. At an earlier period of his life, St. Thomas was not so convinced of this opinion: cf. *Spirit. Creat.*, a. 6, ad. 2; 2, d. 12, q. 1, a. 1, ad. 5. (5) *Sent.*, 2, d. 13, a. 2, q. 1. (6) *Sent.*, 2, d. 12, q. 3, a. 3. (7) *Disp. Met.*, d. 13, s. 10, n. 8.

Primordial Matter—What it is not :—(8) St. Thos., 1 *Met.*, lect. 12; 2 *de Gen.*, lect. 4; Suarez, *D.M.*, d. 13, ss. 2, 3; Pontius, *Curs. Phil.*, d. 32, n. 6; Scotus (?), *Phys.*, 1, qq. 17, 18, 19, 20; Fr. Pitigianus *in Scot. Phys.*, 1, qq. 17-20; Scotus, *Met.*, 1, s. 3; Cavellus, *in Scot. Met.*, 1, s. 3. (9) *De Gen.*, ii,

tr. i. c. 4. (10) St. Thos., 1 *Met.*, lect. 4 ; 1 *Phys.*, lect. 9 ; 1 *Met.*, lect. 7 ; 1 *de Gen.*, lect. 1 ; 1 *de Gen.*, lect. 22 ; Suarez, *D.M.*, d. 13, s. 2. (11) St. Thos., 7 *Met.* lect. 12 ; *S. Th.*, 1, q. 76, aa. 3, 4 ; *contra Gentes*, ii, c. 58 ; Capreolus, in 2, dist. 15, q. 1 ; Cajetan on *Summa* as quoted ; do., 2 *de An.*, c. 1—and all the Thomists ; Suarez, *D.M.*, *d.* 13, sec. 3, n. 13, etc. ; in reference to non-living bodies, Scotus in 4, dist. 11, q. 3, a. 2 ; Henricus, *Quodlibet*, i, qq. 2, 3 ; do., *Quodlibet*, 3, qq. 13, 14—and all their followers. (12) In 4, dist. 12, q. 1, a. 2 ; *de Nat. Mat.*, cc. 1, 4, 5, 6, 7 ; *S. Th.*, i, q. 76, a. 6, ad. 1 and 2 ; *de Spir. Creat.*, a. 3, ad. 19 and 20 ; *de Gen.*, 1, lect. 10 ; *S. Th.*, i, 2, q. 113, a. 8 ; do., *Quodl.*, i, a. 6, ad. 2 ; Scotus in 4, dist. 12, q. 2 ; Cavellus *in Scot.*, 4, dist. 12, q. 2 ; Suarez, *D.M.*, d. 40, s. 2, n. 7.

Primordial Matter—What it is :—(13) *Met.* 7, lects. 2, 6 ; 1 *Phys.*, lects. 11, 12, 15 ; 12 *Met.*, lect. 2 ; 10 *Met.*, lect. 5 ; 1 *de Gen.*, lect. 20 ; etc. (14) *S. Th.*, i, q. 66, a. 1, ad. 3 ; *S. Th.*, i, q. 77, a. 1, ad. 2 ; i, q. 15, a. 3, ad. 3 ; 1 *Phys.*, lect. 15 ; 2, *contra Gentes*, c. 55 ; *S. Th.*, i, q. 66, a. 1 ; *S. Th.*, i, q. 84, a. 3, ad. 2 ; *S. Th.*, iii, q. 75, a. 3 ; 4, d. 12, q. 1, a. 1 ; 4, d. 12, q. 3, ad. 1 ; *de Spir. Creat.*, a. 2 ; *de Princ. Nat.* (about the middle) ; *de Princ. Nat.* (a few lines from the beginning) ; *de Verit.*, q. 3, a. 5, 3m ; 3, d. 14, a. 4 ; *S. Th.*, i, 4, q., a. 1 ; *de Spir Creat.*, a. 1 ; *de Verit.*, q. 3, a. 5, ad. 1 ; *S. Th.*, i, q. 115, a. 1, ad. 2 ; 1, d. 3, q. 4, a. 2, ad. 4 ; *Quodl.*, ix, a. 6, ad. 3 ; *de Princ. Nat.* (the beginning) ; *de Princ. Nat.* (the middle) ; *de Ente et Ess.*, c. 7 ; 7 *Met.*, lect. 2 ; *de Verit.*, q. 3, a. 5, ad. ult. ; 1 *Phys.*, lect. 13 ; *de Malo*, q. 2. (15) Raphael Ripa, *Comm. de Ente et Essentia*, c. 2, q. 2. (16) *de Gen.*, i, c. 3.

Origin and Unity of Primordial Matter :—(17) St. Thos., 1 *de Gen.*, lect. 9 ; 2, dist. 2, q. 1, a. 2 ; *S. Th.*, 1, q. 16, a. 7, ad. 2 ; etc. (18) St. Thos., *contra Gentes*, 3, c. 22.

A War of Words :—(19) St. Thos., *S. Th.*, i, q. 44, a. 2, ad. 3 ; do., *S. Th.*, i, q. 45, a. 4 ; do., *S. Th.*, i, q. 46, a. 1 ; do., *Quodl.*, 4, a. 1 ; do., *Quodl.*, 3, q. 1 ; Cajetan, *de Ente*, etc., c. 5, q. 8 ; do., i, q. 76, a. 1 ; Ferr., *contra Gentes*, 2, c. 68 ; Soncin, *Met.*, 7, q. 17 ; Javellus, q. 5 ; Durandus, 2, dist. 12, q. 2 ; do., 4, dist. 44, q. 1 ; Complutenses, d. 3, q. 5 ; Aquirre, *Phys.*, d. 5, s. 4. (20) Scotus 2, dist. 12, qq. 1, 2 ; do., *Met.*, 9, q. 1 ; do., *de Rer. Princ.*, q. 7, nn. 1, 3, 6, 7, 8 ; do. (?), *Phys.*, 2, q. 7 ; do., *Met.*, 8, q. 5, n. 3 ; do. (?), *Phys.*, 1, qq. 19, 20, 24 ; Suarez, *D.M.*, d. 13, sec. 4. (21) *Phys.*, i, d. 1, q. 2, a. 2.

The Distinct Existence of Primordial Matter :—(22) Suarez, *D.M.*, d. 31, sec. 1 sqq. ; Aegidius, *de Ente et Essentia*, q. 9 sqq. ; Scotus, 3, dist. 6, q. 1. (23) Henricus, *Quodl.*, i, q. 10 ; do., *Quodl.*, 4, q. 16 ; Scotus, 2, dist. 12, qq., 1, 2 ; Gregory, 2, dist. 12, q. 1 ; Mastrius, *Phys.*, disp. 2, q. 2, a. 2 ; Pontius, *Phys.*, disp. 32, q. 4 ; Frassen, *Phys.*, d. 1, sec. 1, q. 2 ; Suarez, *D.M.*, d. 13, secs. 4, 5 ; Fonseca, *Met.*, 8, c. 1, q. 1 ; Toletus, *Phys.*, 1, q. 13 ; Conimbr., *Phys.*, i, c. 9, q. 6, a. 2. (24) For references see above, note (19). (25) *Contra Gentes*, 2, c. 54. (26) *D.M.*, d. 13, sec. 4, n. 14. (27) St. Thos., *S. Th.*, i, q. 66, a. 1 ; do., *Quodl.*, 3, a. 1. (28) Scotus 2, dist. 12, q. 2 ; Suarez, *D.M.*, d. 15, sec. 9. (29) *Phys.*, i, q. 6.

Possibility of Accidents in Primordial Matter :—(30) St. Thos., 7 *Met.*, lect. 1 ; do., 8 *Met.*, lect. 5 ; do., 4, dist. 12, q. 1, a. 1, sol. 3 ; do., *S. Th.*, i, q. 76, a. 6 ; do., *de Spir. Creat.*, a. 3, ad. 12 and 18 ; do., *Q. d. de An.*, a. 9 ; do., *Ops.*, 31, 32 ; do., *de Gen.*, 1, lects. 9, 10 ; do., *Phys.*, 5, lect. 7 ; do., *Quodl.*, i, a. 6 ; do., *de Gen.*, 2, lect. 4 ; do., *Opus.*, 41 ; do., *c. Gentes*, 2, c. 71 ; do., 4, dist. 10, q. 1, a. 2 ; do., *Op.*, 30, cc. 5, 7 ; do., *de Gen.*, i, lect. 7 ; do., *S. Th.*, iii, q. 77, a. 2 ; do., i, dist. 8, q. 5, a. 2 ; do., 4, dist. 12, q. 1, a. 3 ; Cajetan, *de Ente*, c. 7, q. 16 ; Durand, 1, dist. 8, 2 p., q. 4 ; Capreol, 2, dist. 13, q. 1, concl. 2, 3 ; do., dist. 18, q. 1, concl. 6 ; Soncin, 8 *Met.*, qq. 7, 15, 17, 18 ; Ferr., *c. Gentes*, 4, c. 81, qq. 2, 3 ; Soto, *Phys.*, i, q. 7 ; Aquirre, *Phys.*, disp. 49 ; Fonseca, *Met.*, 8, c. 1, q. 1, sec. 5 ; Scotus, 2, dist. 3, q. 4, nn. 5, 17 ; Scotus, 4, dist. 11, q. 2 ; Pontius, *Phys.*, i, disp. 35, qq. 4, 5 ; Frassen, *Phys.*, 2, disp. 1, sec. 3, a. 1 ; Mastrius, *de Gen.*, disp. 5, q. 3. (31) St. Thos., *S. Th.*, iii, q. 77, a. 1 ; do., *S. Th.*, i, q. 76, a. 6 ; do., *de Spir. Creat.*, a. 3, ad. 19 ; do., *c. Gentes*, 4, c. 81 ; do., *de Gen.*, i, lect. 10. (32) St. Thos., *S. Th.*, i, q. 45, a. 4 ; do., i, dist. 8, q. 4, a. 3 ; do., *de Princ. Nat.* (33) *de Gen.*, i, tt. 23, 24 ; *Phys.*, i, tt, 81, 82 ; *de Gen.*, i, t. 24 ; *de Gen.*, 5, t. 8 ; *Met.*, 7, t. 8 ; *Met.*, 7, t. 4 ; 12 *Met.*, t. 43 ; *in Prædic.*, c. *de Substantia.* (34) St. Thos., *S. Th.*,

i, q. 76, a. 6. (35) *de Gen.*, i, lect. 24; *S. Th.*, i, q. 76, a. 4, ad. 4; *c. Gentes*, 4, c. 35; *S. Th.*, iii, q. 2, a. 1. (36) Scotus, 2, dist. 15, q. u. (37) Cajetan, *S. Th.*, i, q. 76, a. 4; Durandus, 4, dist. 12, q. 3, ad. 2; Ferrarensis, *c. Gentes*, 2, c. 45; do., 4, c. 81; Sonc, *Met.*, i, q. 27; Javellus, *Met.* 8, q. 4; Capreolus, 2, dist. 15; Bannes, *de Gen.*, i, c. 10, q. 3. (38) Gregory, 2, dist. 12, q. 2, a. 2; Marsilius, *de Gen.*, i, q. 7; Aegidius, *Met.*, 7, q. 4; Suarez, *M.D.*, d. 14, s. 3; Toletus, *de Gen.*, i, q. 6. (39) John of St. Thomas, *Cursus Phil. Thom.*, *de Gen.*, q. 1, aa. 6, 7, also q. 9; Aguirre, *Phil. Rat.*, disp. 49, 50, 51. The Scotists held that there was in living beings a bodyform (*forma corporeitatis*), and in these cases denied the destruction at death of *all* the accidents: cf. Mastrius, Pontius, Frassen as quoted above in note (30). (40) St. Thos., 3, d. 3, q. a. 2. (41) St. Thos., *de Verit.*, q. 28, a. 8, ad. 7. (42) St. Thos., *de Verit.*, q. 28, a. 7, ad. 11. (43) St. Thos., *de Verit.*, q. 28, a. 8; do., 3, d. 13, q. 3, a. 1. (44) St. Thos., *de Verit.*, q. 28, a. 9, ad. 5. (45) John of St. Thos., *C. P. Th. de Gen.*, q. 1. (46) St. Thos., *de Verit.*, q. 29, a. 1, ad. 10. (47) St. Thos., *S. Th.*, i, q. 76, a. 6, ad. 1. (48) St. Thos., *Q. de An.*, a. 9. (49) St. Thos., *de Spir. Creat.*, a. 2. (50) St. Thos., *de Spir. Creat.*, a. 3. (51) *S. Th.*, i, q. 77, a. 8. (52) St. Thos., *Q. de An.*, a. 19, ad. 2. (53) Cajetan in i, q. 77, a. 1; Capreolus, 1, dist. 3, a. 2; John of St. Thos., *Log.*, q. 15, a. 5; Complut., *Log.*, d. 12, q. 5; Mastrius, *Log.*, d. 7, q. 1; Pontius, *Log.*, d. 12, q. 3; Suarez, *D.M.*, d. 14, sec. 4. (54) *S. Th.*, iii, q. 77, a. 2.

The Nature of Substantial Form:—(55) Comm., *de Ente et Ess.*, c. 5, q. 9. (56) St. Thos., *S. Th.*, i, q. 54, aa. 2, 3; do., *de Spir. Creat.*, a. 11; do., *S. Th.*, i, q. 67, a. 3, ad. 3; do., 2, dist. 13, a. 3, ad. 7; do., *de Cœlo*, 2, lect. 10; do., *Phys.*, 7, lects. 3, 4; do., *de Gen.*, i, lect. 18; etc., etc.; Suarez, *D.M.*, d. 15, sec. 1.

The Unicity of Substantial Form in Non-living Bodies:—(57) *de Gen.*, i, t. 84; *de Gen.*, 2, t. 48; *de Cœlo*, 3, t. 32; *de Gen.*, i, c. 10. (58) Avicenna, i, Sufficient, c. 10; Averroes, *de Gen.*, c. *de Mixtione*; do., *de Cœlo*, 3, t. 87; Albertus Magnus, *de Cœlo*, 3, tr. 2, cc. 1, 8; do., *de Gen.*, i, tr. 6, cc. 2, 5, 6, 7, 11, 8; do., *de Gen.*, i, tr. 5, c. 6; do., *de Gen.*, 2, tr. 2, c. 15. Cf. de Barberis, *Cursus Philosophicus ad mentem S. Bonaventurae*, iii, tr. 4, q. 6, no. 133. (59) St. Bonaventure, 4, d. 49, p. 2, sect. 2, a. 1, q. 1; Aureolus, *Quodl.*, 14; do., 2, dist. 15, aa. 1, 2; Niphus, *de Gen.*, i, text 118; do., *Met.*, 8, d. 4. (60) *S. Th.*, i, q. 76, a. 4, ad. 4; do., *de Gen.*, 1, lects. 24, 25; do., *Quodl.*, i, q. 4, a. 6, ad. 3m; do., *Q. de An.*, a. 9, ad. 10; do., *de Mixt. Elementorum*; do., *de Gen.*, 2, lect. 8; do., *de Cœlo*, 3, lect. 8; do., *de Plur. Form.*; do., *c. Gentes*, 4, c. 35; do., *c. Gentes*, 2, c. 56; do., 2, dist. 18, q. 1, a. 2. (61) *De Mixt. Elem.*; *de Gen.*, i, lect. 8. (62) *De Mixt. Elem.* (63) *de Potentia*, q. 5, a. 8. (64) *S. Th.*, i, q. 96, a. 4, ad. 4. (65) 2, dist. 30, q. 2, a. 2. (66) Henricus, *Quodl.*, 1, qq. 2, 3; do., *Quodl.*, 3, qq. 13, 14; Scotus, 2, d. 15, q. 1; Lychet., *in Scot.*, 2, d. 15, q. 1; Suarez, *D.M.*, d. 15, sec. 10; Hervaeus, *de Plur. Form.*, q. 15; Aegidius, *Quodl.*, 4, q. 11; Pontius, *de Gen.*, d. 5, q. 2; Conimbric., *de Gen.*, i, c. 10, q. 3; Aguirre, *de Gen.*, d. 62.

The Simplicity of the Substantial Form of Non-living Bodies:—(67) St. Thos., 4, d. 10. a. 3, q. 3. (68) St. Thos., *de Nat. Mat.*, c. 5. (69) St. Thos., *de Nat. Mat.*, c. 5; do., *de Nat. Mat.*, c. 9; do., *de Spir. Creat.*, a. 4.

Origin of Substantial Form:—(70) *Met.*, 7, cc. 8, 9. (71) 2, d. i, q. 1, a. 4, ad. 4; *S. Th.*, i, q. 45, aa. 4, 8; *S. Th.*, i, q. 110, a. 2, ad. 3; *de Pot.*, q. 3, aa. 8, 11; *de Virt.*, q. 1, a. 8; *de Verit.*, q. 11, a. 1; *Met.*, 7, lect. 7, 8; 2, d. 18, q. 2, a. 1; *de Pot.*, q. 5, a. 1. (72) *S. Th.*, i, q. 110, a. 2. (73) 3, d. 33, q. 1, a. 2, s. 2; cf. *c. Gentes*, 3, c. 69, n. 9. (74) 2, d. 1, q. 1, a. 4, ad. 4. (75) *de Pot.*, q. 3, a. 8; cf. *S. Th.*, i, q. 118, a. 1; i, q. 65, a. 4; i, q. 90, a. 3; *de Sensu et S.*, lect. 7. (76) Soto, *Phys.*, 1, q. 7; Sonc., *Met.*, 7, q. 28; Durandus, 2, d. 18, q. 2; Aureolus, 2, d. 18. (77) B. Pererius, S. J., *de Comm. omnium rer. nat. principiis etc.*, l. 4, c. 22. (78) Suarez, *D.M.*, d. 15, sec. 2 sqq.; Scotus, 2, d. 18, q. 1. (79) St. Thos., *S. Th.*, i, q. 77, a. 6. (80) *de Spir. Creat.*, q. 1, a. 11. (81) St. Thos., *S. Th.*, iii, q. 77, a. 3, ad. 3; i, q. 57, a. 1, ad. 4; i, i, q. 115, a. 1, ad. 5; i, q. 45, a. 8, ad. 2; i, q. 115, a. 1, ad. 5; iii, q. 77, a. 3, ad. 2; i, q. 77, a. 1, ad. 4; 4, dist.

12, q. 1, a. 2, q. 2 ; 4, dist. 1, q. 1, a. 4, q. 1 ; *de Verit.*, q. 27, a. 4. (82) St Thos., *S. Th.*, i, q.77, a. 1. Cf. i, q. 54, a. 1, 2, 3 ; *de An.*, q 1, a. 12 ; *c. Gentes.*, 3, c. 69 ; Cajetan, *in S. Th.*, i, q. 54, a. 3, and other texts ; Capreol., 3, dist. 3, q. 3, a. 2 ; do., 4, dist. 12, q. 1, a. 3 ; Goudin, *Phys.*, 1 Part, Thesis II. (83) Scotus, 1, dist. 37 ; Lychet., *in Scot.*, 1, dist. 37 ; Scotus, 4, dist. 12, q. 3 ; Hiquaeus, *in Scot.*, 4, dist. 12, q. 3 ; Durandus, 2, dist. 1, q. 4 ; Pontius, *Phys.*, 2, disp. 38, q. 2 ; Mastrius, *Phys.*, disp. 7, q. 6, a. 2 ; Frassen, *Phys.*, disp. 2, sec. 1, a. 2 ; Ockham, 2, q. 23 ; Dandinus, *de An.*, i, q. 8 ; Suarez, *D.M.*, d. 18, sec. 2. (84) St. Thos., *de Pot.*, q. 3, a. 4, ad. 7. (85) St. Thos., *S. Th.*, i, q. 66, a. 2 ; do., *de Pot.*, q. 5, a. 4, ad. 9.

At the end of the notes to Chapter IV., attention was drawn to Palmieri's suggestion that Aristotle did not defend " explicit " hylemorphism. He makes a somewhat similar suggestion about St. Thomas : he is doubtful whether St. Thomas taught a real distinction between primordial matter and substantial form—the genuine issue, as he rightly says, in peripatetic hylemorphism. (*Instit. Phil.*, *Cosmologia*, c. 2, th. xxi.) This doubt of his is as unfounded as his Aristotelian myth. Every text of St. Thomas that we have quoted throughout our present chapter about primordial matter in the paragraphs dealing with its potency, its distinctive existence, its capability of supporting accidents implies clearly a real distinction between primordial matter and substantial form. But St. Thomas's texts about the disappearance of the form during substantial change and the persistence of the primordial matter remove all possibility of doubt on this question : realities that are separable from each other are obviously really distinct. Numerous and decisive as are the texts we have given from St. Thomas, they might be reinforced by others equally decisive and more numerous. (Cf. Almannus, *Summa Philosophiæ*, tome i, sec. 2, qq. 3, 4, 6, 8, 9 ; tome ii, sec. 3, qq. 27, 35, 46 ; tome iii, sec. 6, qq. 34 ; appendix, qq., 1, 2, 6.) Palmieri ignores all these texts. Nor can he quote a single text that denies this real distinction. His defence consists in quoting four Thomistic principles and in inferring from them this doubt of his. The four principles are : the whole, not the form, is made ; the form is educed from the potency of matter ; matter cannot exist apart from form ; the form is induced by physical motion and is the term of alteration. Palmieri's attempt to infer from these principles a denial of the real distinction between primordial matter and substantial form needs no special discussion here : St. Thomas's personal explanation of their genuine meaning occurs again and again in this chapter and in the next. Zigliari, as contemporary of Palmieri at Rome, found it advisable to give a detailed refutation of this attempt to falsify the teaching of St. Thomas (*Cosm.*, ii, c. 2, a. 3 : also vol. iii, appendix). Five years later Fr. T. Pesch, S.J. (*Phil. Nat.*, vol. i, p. 203) could write : " That St. Thomas is a loyal Aristotelian on this question (the real distinction between primordial matter and substantial form) can be doubted only by one who either never read the text of the Angelical or barely glanced at it." And Fr. de San, S.J., refuses to discuss the question : " We need not waste time over this author's assertion that it is doubtful whether St. Thomas taught this point on which depends the whole strength of the Peripatetic theory. That assertion is too paradoxical. Only a man incapable of distinguishing between what is evident and what is doubtful would set about refuting it." (*Cosm.*, p. 166.)

CHAPTER VI.

Primordial Matter and the Essence :—(1) Averroes, 7 *Met.*, comm. 21 and 34 ; Jandunus, 7 *Met.*, q. 12 ; Durandus, 4, dist. 44, q. 1 ; Alexander of Hales, 2, dist. 30 ; do., 4, dist. 44, q. 1 ; Albertinus, 2 *Phys.*, text 28 ; Zimara, 2 *Phys.*, text, 28 ; Pereira, l. 6, c. 7 ; Arist., 2 *Phys.*, text, 28 ; do., *Præd.*, c. 6 ; do., 7 *Met.*, c. 11 ; do., 5 *Met.*, c. 2 ; do., 1 *Met.*, c. 7, t. 52 ; do., 2 *de An.*, c. 2. (2) St. Thos., 7 *Met.*, lects. 5, 9 ; do., *Op.*, 30, c. 2 ; do., 8 *Met.*, lect. 3 ; do., *Quodl.*, 2, a. 4 ; do., 4, dist. 44, q. 1, a. 1, sol. 2, ad. 2 ; do., *S. Th.*, i, q. 29, a. 2, ad. 3 ; do., *S. Th.*, i, q. 75, a. 4 ; do., *de Pot.*, q. 9, a. 1, ad. 6 ; do., 3, dist. 6 ; do., 3, dist. 5, q. 3, a. 2 ; do., 1, dist. 23, q. 1, a. 1 ; Cajetan, *de Ente et Essent.*, c. 2, q. 4 ; Capreol., 4 dist., q. 1, a. 1 ; Aegidus, 7 *Met.*, q. 2 ; Scotus, 3, dist. 22, q. u. ; do., 7 *Met.*, q. 16 ; Suarez, *D.M.*, d. 36, sec. 2 ; Aversa,

q. 19. sec. 4; Amicus, *Phys.*, i, tr. 6, q. 6; Pontius, *Phys.*, i, disp. 35, q. 3; Ockham, in 4, q. 11; Conimbr., *Phys.*, i, c. 9. q. 5; Soares, *Phys.*, i, disp. 4, sec. 2.

The Problem of Union:—(3) Scotus, 2, dist. 3, q. 4; do., 4, dist. 12; do., 3, dist. 1, q. 1; do., 2, dist. 1, q. 5; Suarez, *D.M.*, disp. 13, sec. 9; do., *de Incarn.*, disp. 8, sec. 3; Bannes, i, q. 76, a. 1, dub. 3; Cabrera, iii, q. 2, a. 4, disp. 8, n. 27; Complut., *Phys.*, disp. 6, q. 2; Pontius, *Phys.*, i, d. 34, qq. 2, 3; Aguirre, *Phys.*, d. 34; Rubius, *Phys.*, i, tr. 2, q. u.; Soares, *Phys.*, i, disp. 5. (4) St. Thos., *S. Th.*, iii, q. 2, a. 1; do., *S. Th.*, i, q. 76, a. 7; do., *Met.*, 8, lect. 5; do., 3, dist. 2, q. 2, a. 2; do., *de Spir. Creat.*, a. 3; do., *Q. de An.*, a. 9, ad. 18; cf. also, C. Alemanni, appendix (de F.), q. 6, a. 2; Cajetan, in iii, q. 2, aa. 7, 10; Goudin, *Phys.*, i, disp. 1, q. 4, a. 2; John of St. Thomas, *Phys.*, q. 6, a. 3; Köndig et Hueber, *Harm. Phil.*, Phys., theor. 5, sec. 2. (5) St. Thos., 8 *Met.*, lect. 5; do., *S. Th.*, i, q. 76, a. 7; do., 3, dist. 2, q. 2, a. 3; do., *c. Gentes*, 2.

The Problem of Totality:—(6) Scotus, 3, dist. 2, q. 2; do., 8 *Met.*, q. 4; Mairon, d. 1, q. 10; Mastrius, *Phys.*, d. 5, q. 13, n. 151; Pontius, d. 35, q. 1; Frassen, *Phys.*, d. 3, q. 1; Hervaeus, *Quodl.*, 2, q. 15; Capreolus, 3, dist. 2, a. 1; Cajetan, iii, q. 6, a. 5; Ferrar, *c. Gentes*, 4, c. 81; Javellus, 7 *Met.*, q. ult. (7) St. Thos., 4, *c. Gentes*, c. 81, ad. 2; do., 4, dist. 4, q. 1, a. 1; do., *S. Th.*, iii (supp.), q. 79, a. 2, ad. 2; do., 5 *Met.*, lect. 2; Suarez, *D.M.*, d. 36, sec. 3; Durandus, 3, dist. 2, q. 2; Gregory, 1. dist. 24, q. 1, a. 1; Soto, *Phys.*, q. 3; Complut., d. 6, q. 4; John of St. Thos., *Phys.*, q. 6, a. 2; Aguirre, *Phys.*, d. 7; Soares, *Phys.*, i, d. 7, sec. 2.

Essence and Existence:—(8) St. Thos., *S. Th.*, i, q. 3, a. 4; do., *S. Th.*, i, q. 75, a. 5, ad. 4; do., *c. Gentes*, 2, cc. 52, 53; do., *de Ente et Ess.*, c. 5; do., *Quodl.*, 2, a. 3; do., *Quodl.*, 9. a. 6; do., *de Pot.*, q. 7, a. 2; do., *de Pot.*, q. 3, a. 13, ad. 4; do., *c. Gentes*, i, c. 22, n. 2; do., *Op.*, 30, c. 5; do., *Op.*, 69, c. 2; do., *S. Th.*, i, q. 54, a. 1; do., *de Verit.*, q. 2, a. 11; do., 1, dist. 18, q. 1, a. 2; do., 2, dist. 3, q. 1, a. 1; etc.; Capreol., 1, dist. 8, a. 1, q. 1; Cajetan, in i, q. 3, a. 4; do., *de Ente et Ess.*, c. 5, q. 11; Ferrar, *c. Gentes*, 2, c. 52; Soncin., *Met.*, 4, q. 12. (9) Alexander, *Met.*, 7, ad. text, 22; Durandus, i, d. 8, q. 2; Gabriel, 3, dist. 6; Hervaeus, *Quodl.*, 7, q. 9; Suarez, *D.M.*, d. 31, ss. 1, 2, 3; Vasquez, i, d. 179, n. 6; do., iii. q. 17, a. 2; do., iii. d. 72, c. 2. (10) Scotus, 3, dist. 6, q. 1; do., 1, dist. 36; Henricus, *Quodl.*, i, qq. 9, 10; Pontius, d. 69, q. 4; Mastrius, *Met.*, d. 8, q. 2, n. 77. (11) St. Thos., *Comm. in Bœt. de Hebdomad*, lect. 2; do., *de Verit.*, q. 21, a. 1, ad. 8. (12) Capreol., 1, dist. 8, q. 1. (13) Capr., 2, dist. 16, q. 1; Goudin, *Phys.*, i, d. 1, q. 2, a. 2. (14) *Lib. Præd. de Subst.*, q. 1. (15) Bannes, *Comm. in S. Th.*, i, q. 3, a. 4; Blasius a Conc., *Met.*, disp. 7, qq. 1, 2; Dominic. a Flandr., *Met.*, 4, q. 3, a. 6. (16) St. Thos., *S. Th.*, i, q. 3, a. 4; do., *S. Th.*, 1, q. 8, a. 1; do., *S. Th.*, 1, q. 45, a. 5; do., *c. Gentes*, 2, c. 21; do., *c. Gentes*, 3, c. 66; do., *de Verit.*, a. 9, ad. 7; do., *de Pot.*, q. 3, a. 1; do., *de Pot.*, q. 7, a. 2; do., *S. Th.*, 1, q. 104, a. 1; Cajetan, *in locis cit. S. Th.*; Ferrar., in *c. Gentes*, 2, c. 21; do., *in c. Gentes*, 3, c. 66; Scotus, 4, dist. 1, q. 1; Suarez, *D.M.*, d. 31, sec. 9; Mastrius, *Met.*, d. 8, q. 3, n. 156.

The Principle of Individuation in Material Substance:—(17) St. Thos., *de Nat. Mat.*, c. 3. (18) Scotus, 2, dist. 3, qq. 1, 2, 3, 4, 5, 6; Frassen, *Phil. Acad.*, Log., d. 2, s. 3; Pontius, *Curs. Phil.*, d. 6, qq. 1-7; Mastrius, *Met.*, d. 10, q. 9, n. 126. (19) Suarez, *D.M.*, d. 5, secs. 1-6; Toletus, in i, q. 50, a. 4; Valentia, in i, d. 4, q. 1; Vasquez, in i, d. 181, c. 3; Soares, *Met.*, i, d. 4, sec. 6; Fonseca, *Met.*, 5, c. 6, q. 5. (20) St. Thos., *S. Th.*, i, q. 3, a. 3; do., *S. Th.*, i, q. 39, a. 1, ad. 3; do., *S. Th.*, i, q. 50, a. 4; do., *S. Th.*, i, q. 56, a. 1, ad. 2; do., *S. Th.*, i, q. 75, aa. 4, 5; do., *S. Th.*, i, 2, q. 63, a. 1; do., *S. Th.*, iii, q. 77, a. 2; do., *c. Gentes*, i, c. 21; do., *c. Gentes*, 3, c. 65; do., *de Pot.*, q. 9, a. 1; do., *de Spir. Creat.*, a. 5, ad. 8; do., *Quodl.*, 7, a. 3; do., *Quodl.*, 8, a. 2; do., *de Ente et Ess.*, cc. 2, 6; do., *Op. de. Princ. Indiv.*; do., *Met.*, 7, lect. 15; etc., etc. (21) Capreol., 2, dist. q. 1, a. 1; Ferrar, *in c. Gentes*, i, c. 21; Sonc., *Met.*, 7, qq. 33, 34. (22) Cf. Suarez, *D.M.*, d. 5, s. 3, n. 22. (23) Cajetan, *in de Ente et Ess.*, c. 2, q. 5; Javellus, *Met.*, 5, q. 15; Aegidus, *Quodl.*, 1, q. 5, a. 1; John of St. Thos., *C. Phil.*, part ii, q. 9, aa. 3, 4. (24) In i, q. 29, a. 1. (25) Salmanticenses, *de Princ. Indiv.*, i, disp. 1, dub. 5, n. 132.

Essence and Subsistence:—(26) Henricus, *Quodl.*, 4, q. 4; Durandus, 1, dist. 34, q. 1; St. Thos., 3, dist. 5, q. 1, a. 3, ad. 3; do., 3, dist. 5, q. 3, a. 3, ad. 3; do., *Op. contra Græcos*, etc., c. 6, ; do., *Met.*, 7, lect. 5; do., *S. Th.*, iii, q. 2, a. 2; Scotus, 3, dist. 1, q. 1; do., 3, dist. 6, q. 1; do., 1, dist. 13; do., *Quodl.*, 19, a. 3; Mairon, 3, dist. 1, q. 11; Mastrius, *Met.*, d. 11, q. 4; Pontius, *C.P.*, d. 69, q. 4. (27) St. Thos., *S. Th.*, i, q. 3, a. 3; do., *S. Th.*, iii, q. 4, a. 2; do., *de Unione Verbi Incarn.*, a. 1; do., *Met.*, 7, lect. 11; do., *de Pot.*, q. 7, a. 4; do., *Op.*, 37, c. 4; do., *c. Gentes*, 4, c. 35; Cajetan, in iii, q. 4, a. 2; Ferrar, *c. Gentes*, c. 43; Capreolus, 3, dist. 6, q. 6, a. 3; Javellus, *Met.*, 7, q. 17; Suarez, *D.M.*, d. 35, ss. 1, 2, 3, 4; Vasquez, in iii, q. 4, a. 2, d. 31; Lugo, *de Incarn.*, disp. 12, sec. 2; Soares, *Met.*, tr. 2, d. 2; John of St. Thomas, *Phys.*, q. 7, a. 1; Aguirre, *Phil. Rat.*, Met., d. 6.

The Distinction between Substance and Material Accident:—(28) *de Pot.*, a. 7; *Quodl.*, 9, a. 5, ad. 2. (29) St. Thos., *S. Th.*, iii, q. 77, a. 2; do., 4, dist. 12, q. 1, a. 1; do., *S. Th.*, i, q. 45, a. 1, ad. 2; do., *S. Th.*, i, q. 45, a. 3; do., *S. Th.*, i, q. 77, a. 2, ad. 3; do., *de Gen.*, i, lect. 19; do., *de Sensu et* S., i, lect. 10; do., 1, dist. 3, q. 4, a. 2; do., *de Spir. Creat.*, a. 11; do., *Q. de An.*, a. 12; do., *Quodl.*, 10, a. 5; do., *c. Gentes*, 4, c. 65; do., *Op. contra Græcos*, A. et S., c. 8; Cajetan, *in S. Th.* (*loc. cit.*); Capreol., 2, dist. 18, a. 2; Hervaeus, *Quodl.*, i, q. 15; Soncin., *Met.*, 5, q. 19; Scotus, 4, dist. 12, qq. 2, 3; do., 2, dist. 2, q. 9; Pontius, *C. Phil.*, d. 13, q. 3; Suarez, *D.M.*, d. 40, sec. 2; do., *D.M.*, d. 18, sec. 3; Sylv. Maurus, *Quæst. Phil.*, ii, q. 36; Soto, 4, dist. 10, q. 2, a. 2; Conimbric, *de Gen.*, i, c. 4, q. 6; Fonseca, *Met.*, 5, c. 13, q. 2; John of St.Thos., *Phil. Nat.*, ii, q. 9, a. 2; Toletus in iii, q.75, a. 5; etc., etc. (30) Ockham, 4, q. 4; do., *Quodl.*, 4, qq. 29-30; do., *de Corpore Christi*, c. 17 sqq.; do., *Logica*, c. de Quantit.; Gabriel, 2, dist. 10; Major, 2, dist. 12, q. 2; Adam, in 4, q. 5; Albert. de Sax., *Phys.*, i, q. 7; Marsilius, q. 9, a. 2; and with these, Arriaga, *Curs. Phil.*, Phys., d. 5, s. 1, subs. 6. (31) Suarez, *D.M.*, d. 18, sec. 3, nn. 17, 18. (32) Scotus, 1, dist. 37; do., 4, dist. 12, q. 3, do., 2, dist. 16; do., 2, dist. 9, q. 2; do., 4, dist. 22, q. 3; Pontius, *C. Phil.*, ii, d. 38, qq. 2, 3; Mastrius, disp. 7, a. 3; Arriaga, disp. 11, sec. 2; Frassen, *Phil. Acad.*, Phys., disp. 2, sec. 1, a. 2, q. 2. (33) Suarez, *D.M.*, d. 40, sec. 2, n. 22.

The Origin of Accidents:—(34) Cajetan in i, q. 54, a. 3; Ferrar, *c. Gentes*, 4, c. 65; Conrad, i, 2, q. 110, a. 3; Soto, *in Logica*, c. *de Proprio*; John of St. Thomas, *Phil. Nat.*, i, q. 12, appendix; Complutenses, *Phys.*, d. 10, q. 7; Fonseca, *Met.*, 5, c. 2, q. 6, s. 5; Toletus, *de An.*, 2. q. 9, concl. 4. (35) Scotus, 2, dist. 16; do., 4, dist. 12, q. 3; Pontius, *C. Phil.*, d. 38, q. 3, concl. 1; Frassen, *Phil. Acad.*, Phys., i, d. 2, s. 1, a. 2, q. 2; Suarez, *D.M.*, d. 18, s. 3; Hurtado, *Phys.*, d. 9; Arriaga, d. 11, s. 2; Sylv. Maurus, *Quæst. Phil.*, 4, q. 30, ad. 4. (36) (*a*) Texts that seem not to imply causality:—1, dist. 3, q. 4, a. 2; 1, dist. 3, q. 4, a. 2, ad. 2; *Op.*, i, cc. 87, 89; *de Verit.*, q. 14, a. 5; *S. Th.*, i, q. 77, a. 6, ad. 1, 2; *S. Th.*, i, q. 77, a. 7; *S. Th.*, i, q. 77, a. 1, ad. 1; *S. Th.*, i, q. 18, a. 1, ad. 2; *de Pot.*, q. 3, a. 7. Texts that seem to imply causality:—*S. Th.*, i, q. 77, aa. 6, 8; *S. Th.*, i, q. 77, a. 5, ad. 1, 2; *Q. de An.*, a. 19, ad. 2; *de Spir. Creat.*, a. 11, ad. 5. (37) In i, q. 77, ad. 2 and 3.

The Existence of the Accident:—(38) Capreol., 3, dist. 6, q. 1; do., 3, dist. 16, q. 1; do., 1, dist. 18, q. 1. (39) Scotus, 4, dist. 12, q. 1; Suarez, *D.M.*, d. 31, s. 11, n. 23 sqq.; Molina, in i, q. 3, d. 2. (40) St. Thos., *de Ente et Ess.*, cc. 2, 7; do., *de Spir. Creat.*, a. 3; do., 4, dist. 12, q. 1; do., *c. Gentes*, 4, c. 14; do., *S. Th.*, i, q. 77, a. 2; do., 1, dist. 9, q. 1, a. 2; do., *Phys.*, 5, lect. 9; do., *de Un. Verbi.*, a. 1, ad. 10; Cajetan, *de Ente et Ess.*, q. 16; do., in i, q. 28, a. 2; Soncin., *Met.*, 7, q. 5. (41) St. Thos., *de Ent, et Ess.*, c. 7; do., *S. Th.*, iii, q. 17, a. 2. (42) St. Thos., *Comp. Theol.*, c. 211.

The Individuation of the Accident:—(43) St. Thos., *S. Th.*, i, q. 29, a. 1; do., 2, d. 2, q. 1, a. 2; do., *S. Th.*, 1, q. 39, a. 3; do., *Op. de Prin. Individ.*; do., *Quodl.*, 7, a. 19; do., *S. Th.*, ii, 2, q. 24, a. 5; do., *de Verit.*, q. 1, a. 11; do., *S. Th.*, iii, q. 35, a. 5; do., *S. Th.*, ii, q. 77, a. 2; do., *Met.*, 7, lect. 15; Cajetan, in *S. Th.*, *loc. cit.*; Capreolus, i, dist. 54, a. 2; John of St. Thos. *C. Phil.*, Phys., 2, q. 9, a. 5. (44) St. Thos., *S. Th.*, i, q. 29, a. 1; do.

S. Th., 1, q. 29, a. 3; do., *Op. de Princ. Ind.* (45) Scotus, 4, dist. 12; Suarez, *D.M.*, d. 5, sec. 7; Lossada, *Met.*, d. 1, c. 6, n. 144; Pontius, *C. Phil.*, d. 6, q. 8; Frassen, *Phil. Acad.*, Log., d. 2, sec. 3, q. 2.

The Introduction of Physical Intrinsic Modes:—(46) Mastrius, *Met.*, d. 2, q. 6, a. 1; Pontius, d. 69, q. 3, *Addit. de modis intrinsecis;* Suarez, *D.M.*, d. 7, sec. 1; do., *D.M.*, d. 13, sec. 9; do., *D.M.*, d. 39, secs. 1, 2; Vasquez, in i, d. 126; do., in iii, d. 31, c. 6; Fonseca, *Met.*, 5, c. 6, q. 6; Rubius, *Phys.*, q. 6; Lessius, *de Div. Perf.*, l. 12, n. 29 sqq. (47) Babenstuber, *Philos.*, *Phys.*, 1, d. 6, a. 2, q. 2. (48) In iii, d. 41, c. 4; in iii, d. 32, c. 4. (49) Köndig et Hueber, *Harm. Phil.*, ii, th. 5; Babenstuber, *Phil.*, Phys., i, d. 6; Cardinal Ptolemaeus, *Phil. Mentis et S.*, Phys.-Met., dist. 5, sec. 3; V. Gufl, *Met.*, iii, tr. 3, a. 2; J. Martinon, *de Incarnat.*, d. 5; C. Tiphanus, *de Hypostasi*, cc. 40-60, and all Nominalists, *teste* Hurtad., *Phys.*, d. 11, s. 2, n. 5. (50) *de Div. Perf.*, l. 12, n. 29. (51) Köndig et Hueber, *loc. cit.*, n. 221. (52) Babenstuber, *loc. cit.*, a. 2, ad. finem. (53) Gufl, O.S.B., *Met.*, P. 3, tr. 3, a. 2.

CHAPTER VII.

Medieval Presuppositions:—(1) Arist., *Met.*, 5, c. 13; do., *Phys.*, 6, c. 1; do., *Phys.*, 5, c. 3; do., *Categ.*, c. 4; St. Thos., *Met.*, 5, lect. 15; do., *Phys.*, 5, lect. 5; Scotus, i, dist. 44, q. 1; Suarez, *D.M.*, d. 40, sec. 1. (2) St. Thos., *S. Th.*, iii, q. 75, a. 5; do., *c. Gentes*, 4, c. 65; do., 4, dist. 1, q. 1, a. 1; do., 4, dist. 12, q. 1, a. 1, ad. 2; Scotus, 4, dist. 10, q. 2; Suarez, *de Euch.*, d. 56, s.1; do., *de Euch.*, d. 51, s. 2. (3) Cf. Chapter VI.—The Distinction between Substance and Material Accidents. (4) Suarez, *de Euch.*, d. 51, s. 2. (5) St. Thos., *S. Th.*, iii, q. 76, a. 4. (6) St. Thos., *S. Th.*, iii, q. 76, a. 4; do., *S. Th.*, q. 76, a. 4, ad. 1.

The Essence of Quantity:—(7) Simplicius who advocated measurableness as the essence of quantity appeals to St. Thos., *de Nat. Loci.* An appeal in favour of this view was made also to Aristotle, *in Præd.*, c. 6; do., *Met.*, 5, c. 13; to Albert. M., tr. 8, c. 1; to Capreolus, 2, dist. 3, q. 1, ad. 11. Soncinas, *Met.*, 5, q. 21, and Javellus, q. 20, advocated divisibility: they appealed to Aristotle, *Met.*, 5, tt. 12, 18, *Phys.*, i, t. 16, *Phys.*, 3, t. 2, *Phys.*, 6, t. 3, *de Cœlo*, i, t 2; also to St. Thom., 2, dist. 3, q. 1, a. 4, *S. Th.*, i, q. 50, a. 2, i, dist. 19, q. 1, a. 1, ad. 1—and several other texts collected by C. Alemanni, *Summa Phil.*, i, q. 9, a. 1. An appeal in favour of this view was made also to Scotus, *in Præd.*, q. 17, and *Met.*, 5, q. 9. Arriaga, *Met.*, d. 5, sec. 2, and Oviedo, *Met.*, Controv., 7, n. 27, advocated impenetrability. Durandus, 4, dist. 10, q. 2, advocated actual local extension: so did the Nominalists as regards the quantity of substance—cf. above, note (3). (8) Capreol., 2, dist. 19, q. 1, a. 3, ad. 2; do., 2, dist. 18, q. 1, a. 3, ad. 2 and 4; Cajetan, in i, q 52, a. 1; Ferrar, *c. Gentes*, 4, c. 87; Complutenses, *Logic.*, q. 3, n. 30; John of St. Thos., *Logic.*, q. 16, a. 1; Vasquez, in iii, d. 187, c. 2, n. 11; do., in iii, d. 190, c. 3, n. 20; do., in iii, d. 194, c. 3, nn. 26, 27; Goudin, *Phys.*, 4, q. 2, a. 3; St. Thos., *S. Th.*, i, q. 50, a. 2; do., *S. Th.*, iii, q. 76, a. 3; do., *c. Gentes*, 4, c. 65; do., *Op.*, 42, c. 16; do., *Op.*, 48, c. 14; do., *Phys.*, 4, lect. 7; do., 4, dist. 10, q. 1, a. 3, ad. 2; do., *Op.*, 70, q. 3, a. 3, ad. 3; do., *Quodl.*, 9, a. 6. A few of these Thomists—for instance, the Complutenses—insist that material substance, even when quantified, has no actual integral parts which are entitatively substantial; for them, therefore, material substance, even when quantified, is wholly indivisible and exists whole in the whole continuum and whole in each part thereof. Cf. Goudin, *loc. cit.* (9) Sotus, *de Præd.*, c. 6, q. 2, ad. 1; Scotus, 2, dist. 12, q. 2; do., 4, dist. 10, q. 1; Mastrius, *Phys.*, d. 9, q. 1, a. 1; Frassen, *Phil. Acad.*, Log., tr. 3, d.s. 2; Pontius, *Phys.*, d. 14, q. 2, concl. 4; Suarez, *D.M.*, d. 40, s. 4, n. 7 seqq.; Fonseca, *Met.*, 5, c. 13, q. 1; Aguirre, *Met.*, d. 8, s. 3.

The Secondary Effects of Quantity:—(10) *Op. in Lib. Bœt. de Trinitate*, q. 4, a. 3. (11) St. Thos., *loc. cit.* (12) St. Thos., *Quodl.*, i, a. 21. (13) 4, dist. 11, q. 1, a. 3, qla. 3, ad. 2. (14) *D.M.*, d. 43, sec. 1, n. 8 sqq.

The Endless Divisibility of Continua:—(15) *Phys.*, 6, c. 1; *Phys.*, 5, c. 3. (16) St. Thos., *Phys.*, 6, lects. 1, 3; do., *de Gen.*, lect. 5; do., *Met.*, 9, lect. 5; do., 2, dist. 30, q. 2, a. 2; do., *S. Th.*, i, q. 48, a. 4; do., *S. Th.*, i, 2, q. 85,

a. 2 ; do., *c. Gentes*, i, c. 12 ; Scotus, 2, dist. 2, q. 9 ; Suarez, *D.M.*, d. 40, s. 5 ; Sotus, *Phys.*, 6, q. 1 ; John of St. Thos., *Phys.*, q. 20 ; Complut., *Phys.*, d. 25 ; Goudin, *Phys.*, i, d. 3, q. 5, a. 1 ; Mastrius, *Phys.*, d. 9, q. 2, a. 2 ; Pontius, (hesitantly) *Phys.*, 6, d. 47, q. 2 ; Lynceus, *Phys.*, 3, tr. 6 and 7 ; Frassen, *Phil. Acad.*, Phys., 2, d. 2, sec. 1, q. 2 ; Toletus, *Phys.*, 6, q. 1 ; Conimbric., *Phys.*, 6, c. 2. (17) Arist., *Phys.*, 6, c. 1. (18) St. Thos., *Phys.*, 6, lect. 1. (19) St. Augustine, *de Immort. An.*, c. 7. (20) St. Thos., *Phys.*, 1, lect. 9. (21) St. Thos., *de Sensu et Sensato*, lect. 15. (22) Scotus, *Met.*, 5, q. 2 ; do., 2, dist. 1, q. 9 ; Ockham, 2, dist. 28 ; Valles., *Phys.*, contr. 5. (23) J. Major, 2, dist. 2, q. 1, concl. 1 ; Gregory, 1, dist. 36, q. 1 ; do., 2, dist. 2, q. 2 ; Tartaretus, *Phys.*, 6, q. 1 ; Lugo, *de Incarn.*, d. 26, s. 8, n. 3 ; do., *de Sacram.*, d. 4, s. 6 ; do., *de Penit.*, d. 16, s. 1 ; Tellez, *Phys.*, 2, l. 6, d. 35, s. 1 ; Arriaga, d. 16 ; Oviedo, *Phys.*, contr. 7. (24) Hurtado, *Phys.*, d. 15, s. 5, sub. 4.

The Manner of Existence of Parts within a Continuum :—(25) St. Thomas, *Phys.*, 8, lect. 21. (26) *Op. de Nat. Mat.* (27) St. Thos., *Met.*, 3, lect. 13. (28) 4, dist. 44, q. 1. (29) 2, dist. 17, a. 1, q. 4. (30) St. Thos., *Phys.*, 1, lect. 3 ; do., *Met.*, 5, lect. 2 ; do., *Phys.*, 1, lect. 9 ; do., *de Cœlo*, i, lect. 2 ; do., *Met.*, 7, lect. 13 ; do., 4, dist. 10, q. 1, a. 3, ad. 1 ; do., *de Sensu et n Sensato*, lect. 13 ; Aegid., *Phys.*, 8, lect. 11 ; do., *Phys.*, 6, lect. 16 ; Capreol., 1, dist. 43, a. 3, q. 1, ad. 3 ; Henric., *Quodl.*, 4, q. 15 ; do., *Quodl.*, 9, q. 4 ; Albertin., *in Præd. Quant.*, d. 3, q. 6, n. 19 ; Amicus, *de Angelis*, d. 9, n. 180 ; Fonseca, *Met.*, 5, c. 13, q. 6, ss. 4, 5 ; Sylv. Maur., *Quæst. Phil.*, ii, q. 40, p. 382 ; Soares, *Phys.*, iv, d. 1, sec. 1. (31) Scotus, 2, dist. 1, q. 3 ; do., 4, dist. 12, q. 4 ; Soncinas, *Met.*, 5, q. 19 ; Soto, *lib. Prædic. de Quant.*, q. 2 ; Suarez, *D.M.*, d. 7, s. 1, nn. 22, 23 ; do., *D.M.*, d. 40, s. 1, n. 7 ; Toletus, *Phys.*, 6, q. 1, concl. 3 ; Conimbric., *Phys.*, 6, cc. 1, 2 ; Complutenses, *Phys.*, d. 25, q. 3 ; Aguirre, *Phys.*, d. 32, sec. 2 ; Mastrius, *Phys.*, d. 9, q. 2, a. 3 ; Pontius (hesitantly), *Phys.*, 6, d. 47, q. 1 ; Hurtado, *Phys.*, d. 15, sec. 1 ; Arriaga, *Phys.*, d. 6, n. 14 sqq.

Indivisibles as Links and Limits in a Continuum :—(32) Scotus, 2, dist. 2, q. 9 ; do., 2, dist. 1, q. 3 ; Suarez, *D.M.*, d. 40, sec. 5 ; Pontius, *Phys.*, 6, d. 47, qq. 3, 4 ; Frassen, *Phil. Acad.*, Phys., 2, d. 2, s. 1, q. 3 ; Mastrius, *Phys.*, d. 9, q. 2, a. 2 ; Conimbric., *Phys.*, 6, q. 29, a. 2 ; Arriaga, *Phys.*, d. 16, sec. 7 ; Oviedo, *Phys.*, contr. 17, punct. 1 ; Complut., *Phys.*, d. 25, q. 1. (33) Albert. M., *de Indivisibilibus*, c. 7 ; St. Thos., *de Gen.*, 1, lects. 4, 5 ; do., *Phys.*, 6, lects. 8, 9 ; do., 3, dist. 21, q. 1, a. 1, ad. 5 ; do., *Phys.*, 5, lect. 5 ; do., *Phys.*, 7, lect. 3 ; do., *de Cœlo*, 1, lect. 2 ; do., *de Tot. Log. Arist. Summa.*, tr. 3, c. 3 ; do., *Met.*, 3, lect. 13 ; do., *de Pot.*, q. 3, a. 17, ad. 5 ; do., *de Instantibus*, c. 2 ; Durandus, 2, dist. 2, q. 4 ; Ockham, *Log.*, c. de Quantitate ; do., *de Euchar.*, cc. 1, 2 ; Gregory, 2, dist. 2, q. 2, a. 1 ; De Rhodes, *Phil. Peripat.*, 2, d. 3, q. 2, s. 3 ; Pereira, *Phys.*, l. 10, c. 5 ; Albertinus, *de Quant.*, d. 3, q. 7 ; Dandinus, *de An.*, Comm., 111 ; Rubius, *Phys.*, 6, tr. de. comp. Cont., q. 1, d. 2 ; Tanner, t. 1, d. 2, q. 4, n. 23 ; Soares, *Phys.*, tr. 4, d. 1, s. 3, p. 2.

CHAPTER VIII.

(1) *Categ.*, c. 6-8 ; do., *Met.*, 5, c. 14. (2) St. Thos., *S. Th.*, i, q. 28, a. 2 ; do., *S. Th.*, i, 2, q. 49, aa. 1, 2 ; do., *Met.*, 5, lect. 16 ; do., *Met.*, 5, lect. 9 ; do., *Phys.*, 3, lect. 5 ; do., *S. Th.*, i, 2, q. 50, a. 2, ad 3 ; do., 4, dist. 4, q. 1, a. 1 ; do., *Tot. Log. Summa.*, tr. 4 ; Scotus, 4, dist. 12, qq. 2, 4, 10 ; Suarez, *D.M.*, d. 42. (3) Albert M., *Sup. Prædic.*, c. 1. (4) Goudin, *Logica*, q. 5, a. 1. (5) Suarez, *D.M.*, d. 42, sec. 1, nn. 5, 6.

Astronomy and Alchemy :—(6) Alfraganus, *Elementa Astronomica* (1669) ; Aguirre, *de Cœlo*, d. 67. (7) St. Thos., *Meteor.*, 3, lect. 9 ; Albert. M., *de Alchimia*, par. 2.

The Medieval Distinction between Primary and Secondary Qualities :—(8) St. Thos., *de Gen.*, 2, lects. 2, 3 ; do., *de An.*, 2, lect. 13 ; do., *de Cœlo*, lect. 10 ; do., *de Sensu et Sens.*, lect. 10 ; do., *Met.*, 10, lects. 4, 6 ; Pontius, *C.P.*, d. 56, q. 3 ; Conimbric., *de Gen.*, 2, c. 3, qq. 2, 3 ; Soares, *de Gen.*, d. 4, sec. 2. (9) Arist., *de An.*, 2, c. 2 ; do., *de An.*, 3, cc. 1, 4 ; do., *de Sensu et*

Sens., cc. 1, 4 ; do., *de An.*, 2, c. 6 ; St. Thos., *de An.*, 2, lect. 13 ; do., 4, dist. 49, q. 2, a. 2 ; do., *de Sensu et Sens.*, lect. 11 ; do., *de An.*, 3, lect. 1 ; do., *de Sensu et Sens.*, lect. 2 ; do., *S. Th.*, i, q. 78, a. 3.

The Medieval Theory of Sense-Perception :—(10) Frags. 125, 9, 117, 11—cited in this order. (11) St. Thos., *de An.*, 3, lect. 1 ; do., *de An.*, 2, lects. 15, 16, 17, 19, 20, 21, 22, 23 ; do., *de Sensu et Sens.*, lects. 12, 13, 14, 5 ; do., *S. Th.*, i, q. 78, a. 3, ad. 3 ; Complut., d. 11, n. 43. Scotists postulated a medium only for sight :—Scotus, *de An.*, q. 4 ; Cavellus, *de An.*, q. 4 ; Pontius, d. 59, q. 3. Suarez, *de An.*, cc. 17, 21, 24, etc. (12) St. Thos., *de An.*, 2, lects. 10, 11, 12 ; do., *c. Gentes*, 2, c. 66 ; do., *de Sensu et Sens.*, lect. 3 ; do., 3, dist. 19, q. 1, a. 1. (13) St. Thos., *de An.*, 2, lect. 20 ; do., 2, dist. 2, q. 2, a. 2, ad. 5 ; Suarez, *de An.*, 3, c. 21, n. 1 ; Conimbric., *de An.*, 2, c. 9, q. 3 ; do., *de An.*, 2, c. 8, q. 2, a. 2 ; Complut., *de An.*, d. 12, q. 2 ; do., *de An.*, 2, d. 12, q. 5 ; John of St. Thos., *de An.*, q. 5, a. 4 ; do., *de An.*, q. 7, a. 3. (14) St. Thos., *S. Th.*, i, q. 17, aa. 2, 3 ; do., *S. Th.*, i, q. 85, a. 2 ; do., *de Verit.*, q. 2, aa. 2, 6 ; do., *S. Th.*, i, q. 78, a. 3 ; do., i, dist. 35, q. 1, a. 1, ad. 3 ; do., *Quodl.*, 8, a. 4 ; do., *Phys.*, 7, lect. 4 ; do., *de An.*, 2, lects. 6, 16 ; do., *de An.*, 3, lect. 17 ; do., *de Verit.*, q. 10, a. 8, ad. 1 ; do., *de Cœlo*, 2, lect. 12 ; do., 4, dist. 44, q. 1, a. 3, sol. 4 ; do., 4, dist. 44, q. 2, a. 1, sol. 3, 4 ; Suarez, *de An.*, 3, cc. 1, 2 ; Soares, *de An.*, tr. 7, d. 1. The Nominalists denied the existence of this impressed form : the Scotists admitted its need for some senses, but not for all ; cf. Pontius, d. 59, q. 6. (15) Arist., *de Somno.*, 2, 454^a 7. Cf. St. Thos., i, dist. 40, q. 1, a. 1 ; do., i, dist. 15, q. 5, a. 3, ad. 4 ; do., *de Verit.*, q. 8, a. 6 ; do., *de Pot.*, q. 10, a. 1 ; do., *de Sensu et Sens.*, lect. 4 ; do., *de An.*, 3, lect. 12 ; do., *de Somno*, lect. 1. (16) St. Thos., *S. Th.*, i, q. 17, aa. 2, 3 ; do., *S. Th.*, q. 85, a. 6 ; do., *de Verit.*, q. 1, a. 11 ; do., *de An.*, 3, lects. 11, 13 ; Suarez, *de An.*, 3, c. 10 ; Scotus, 1, dist. 3, q. 4 ; Aguirre, *de An.*, d. 85, n. 39 ; Conimbric., *de An.*, 2, c. 6, q. 6 ; Pontius, *C.P.*, d. 59, q. 2 ; Frassen, *Ph. Ac.*, Phys., 3, d. 3, s. 3, a. 1.

The Democritean Theory of the Proper Sensibles :—(17) Theophr., *de Sens.*, pars. 49, 50 ; Arist., 405^b 12-16 ; Sext. Emp., *adv. Math.*, 7, par. 116 ; Mullach, *Dem.*, pp. 206, 401 ; Arist., 442^a 29 ; Stob. Ecl., 1, 16 (Diels, *Dox.*, p. 314) ; Theophr., *de Sens.*, par. 57 ; Arist., *de Sens.*, iv, 442^a 29. (18) Theophr., *de Sens.*, par. 76-78 ; Arist., 303^a 14 ; do., 329^b 26 ; Theophr., *de Sens.*, par. 18. (19) Theophr., *de Sens.*, par. 69 ; do., *de Sens.*, pars. 64-67 ; Mullach, *Democ.*, p. 219 ; Theophr., *de Causis*, Pl. VI., 1, 6. (20) Arist., *de Sens.*, iv, 442^a 29 ; Mullach, *Democ.*, p. 405 ; Theophr., *de Odor.*, pars. 64, 57, 63, 82. (21) Theophr., *de Sens.*, pars. 55-56 ; Diels, *Dox.*, 515 ; Mullach, *Democ.*, pp. 212-213, 342-344. (22) St. Thos., *de Gen.*, 2, lect. 2. (23) St. Thos., *de Gen.*, 1, lect. 22. (24) St. Thos., *de Gen.*, 1, lect. 3 ; do., *de Sensu*, lect. 6 ; do., *de Sens.*, lect. 8 ; do., *de Sens.*, lect. 12. (25) St. Thos., *de Sens.*, lect. 11 ; do., *de Sens.*, lect. 9 ; do., *de Sens.*, lect. 10. (26) St. Thos., *de Sens.*, lect. 12 ; do., *de Sens.*, lect. 11. (27) St. Thos., *de An.*, 2, lects. 16, 17, 18 ; do., *de Sens.*, lect. 16. (28) St. Thos., *de Sens.*, lect. 9. (29) St. Thos., *de An.*, 3, lect. 2. (30) St. Thos., *de An.*, 2, lect. 16. (31) St. Thos., *de An.*, 3, lect. 2. Cf. St. Thos., *de An.*, 2, lects. 6, 8, 12, 13, 24 ; do., *de Sens.*, lects. 6, 15, 16. (32) St. Thos., *de An.*, 3, lect. 2. (33) This Aristotelico-Thomistic teaching on the extra-mental existence of the proper sensibles as formal accidents distinct from quantity and motion was followed by the whole School. Two minor controversies arose concerning sound : one over the question whether sound was a permanent or successive quality ; another on the question whether sound as a formal quality resided in the vibrating body or in the medium. St. Thomas held that sound was a successive quality residing in the medium and most of the Schoolmen endorsed this view. There were, however, dissenters on both points : and on the second question, compromisers who combined the two views. A more important controversy about the nature of colour will be referred to when discussing the quality of light. Cf. Conimbric., *de An.*, cc. 8, 9, 10, 11 ; Pontius, *C.P.*, d. 60 ; Frassen, *Phil. Ac.*, Phys., 3, d. 3, sec. 3, a. 2 ; John of St. Thos., *de An.*, qq. 4, 5, 6, 7 ; Goudin, *Phys.*, 4, q. 3, aa. 1, 2 ; Suarez, *de An.*, l. 3 ; Soares, *de An.*, tr. 2, d. 2.

Light and Brightness :—(34) St. Thos., *de An.*, 2, lects. 14, 15 ; do., 2, dist. 13, q. 1, a. 3 ; do., *S. Th.*, i, q. 67, a. 3 ; Scotus, 2, dist. 13 ; Suarez, *de*

An., 3, c. 14. (35) St. Thos., *de Sens.*, lect. 6 ; do., *de An.*, 2, lect. 14 ; do., *de An.*, 2, lect. 15. (36) See note (34) ; also, St. Thos., *de Sens.*, lect. 11. (37) Albert M., *de Sens.*, tr. 2, c. 1 ; do., *de An.*, 2, tr. 3, c. 7 ; do., *Summa de Creaturis*, ii, q. 21, a. 3, part 1 ; Aegidius, *de An.*, 2, c. 7 ; Cajetan, *de An.*, 2, c. 7 ; Javellus, *de An.*, 2, q. 33 ; Soncinas, *Met.*, 10, q. 2 ; Ferrar., *de An.*, q. 13. These appealed to Arist., *de An.*, 2, t. 67, and *de Sens.*, c. 3, and to St. Thos., i, dist. 17, q. 1, a. 1. (38) St. Thos., *de An.*, 2, lects. 14, 15, 16 ; do., *de An.*, 3, lect. 2 ; do., *de Sens.*, lects. 2, 6, 7 ; do., *Quæst. de An.*, a. 4, ad. 4 ; do., *Quodl.*, 7, a. 1 ; Conimbric., *de An.*, 2, c. 7, q. 2 ; John of St. Thos., *de An.*, q. 7, a. 2 ; Suarez, *de An.*, 3, c. 15 ; Soares, *de An.*, tr. 2, sec. 2, 7. (39) St. Thos., *S. Th.*, i, q. 67, a. 3 ; do., 2, dist. 13, q. 1, a. 3 ; do., *de An.*, 2, lect. 14 ; St. Bonaventure, 2, dist. 13, q. 2 ; Richard of Middletown, 2, dist. 13, q. 2 ; Durandus, 2, dist. 13, q. 2 ; Hervæus, *Quodl.*, 3, q. 18 ; Suarez, *de An.*, c. 14 ; Soares, *de An.*, tr. 2, d. 2, s. 2, a. 6 ; John of St. Thos., *de An.*, q. 7, a. 2. (40) Scotus, 2, dist. 13 ; Aegidius, *de An.*, 2, t. 76, dd. 2, 3 ; Alex. Thiens., *de An.*, 2, t. 71 ; Buridan, q. 17 ; Cabeus, *Meteor*, 3, t. 6, q. 2 ; Pontius, *C.P.*, d. 60, q. 1, concl. 5.

Gravity and Levity :—(41) St. Thos., *de Cœlo*, i, lects. 3, 5 ; do., *de Cœlo*, 3, lects. 5, 7 ; do., *de Cœlo*, 4, lects. 2, 3 ; do., *de Gen.*, 2, lect. 3 ; do., *S. Th.*, i, q. 46, a. 7 ; do., *de Gen.*, 2, lect. 1 ; do., *de An.*, 2, lect. 13 ; do., *de Cœlo*, 2, lect. 10 ; do., *Phys.*, 8, lect. 14 ; do., *Op. de Nat. Mat.*, c. 1 ; Conimbric., *de Cœlo*, 4, c. 4 sqq. ; Rubius, *de Cœlo*, 3, c. 8, q. 2 ; do., *de Cœlo*, 4, qq. 1, 2 ; Aguirre, *Phys.*, d. 58, sec. 2 ; de Rhodes, *Phil. Perip.*, l. 2, d. 9 ; Soares, *de Gen.*, d. 4, s. 4. (42) Scotus, 2, dist. 2, q. 10 ; Gregory, dist. 6, q. 1, a. 3 ; Mairon., dist. 14, q. 6 ; Placa, *Phys.*, 2, d. 5, q. 7 ; Pererius, l. 6, c. 16 ; Cabero, *Phys.*, 7, d. 1, dub. 5 ; Pontius, *Phys.*, d. 48, q. 1 ; Aversa, q. 14, s. 5 ; Arriaga, *de Gen.*, d. 3, s. 10 ; Mastrius, *de Cœlo*, d. 3, q. 2, n. 20 seqq. (43) St. Thos., *S. Th.*, i, q. 18, a. 2 ; do., *S. Th.*, q. 105, a. 2 ; do., *c. Gentes*, 2, c. 46 ; do., *c. Gentes*, 3, c. 28 ; do., *Phys.*, 8, lect. 8 ; do., *de Cœlo*, 2, lect. 2 ; do., 2, dist. 14, q. 1, a. 3 ; Capreol., 2, dist. 6, a. 3 ; Cajetan in i, q. 18, a. 1 ; Ferrar., *c. Gentes*, 1, c. 97 ; do., *Phys.*, 8, q. 9 ; Soncin., *Met.* 9, q. 7 ; Sotus, *Phys.*, 8, q. 3 ; John of St. Thos., *Phil Nat.*, 1, q. 23, a. 1 ; Complut., *Phys.*, d. 28, q. 2 ; Suarez, *D.M.*, d. 18, sec. 7 ; Fonseca, *Met.*, 5, c. 4, q. 2, sec. 7 ; Conimbric., *Phys.*, 8, c. 4, q. 1, a. 2. Cf. Chapter IX—Distinction between the Mover and the Moved.

Density and Rarity :—(44) St. Thos., *Phys.*, 4, lect. 14 ; do., *de Meteor.*, lect. 16 ; do., *Phys.*, 7, lects. 4, 5 ; do., *de Gen.*, 1 lect. 14 ; do., *Phys.*, 8, lect. 14 ; do., *de Cœlo*, 3, lect. 3 ; do., *de Cœlo*, 2, lect. 22 ; do., 1, dist. 17, q. 2, a. 1 ; do., 4, dist. 12, q. 1, sol. 3, ad. 6 ; do., *S. Th.*, iii, q. 77, a. 2, ad. 3 ; do., *S. Th.*, iii, q. 77, a. 7, ad. 1 and 2 ; Capreol., 2, dist. 19, q. 1, a. 3 ; Soncin., *Met.*, 8, q. 27 ; Conimbric., *de Gen.*, 1, c. 5, q. 17 ; Durandus, 1, dist. 17, q. 7 ; do., 2, dist. 18, q. 1 ; John of St. Thos., *Phys.*, q. 7, a. 1 ; Compluten., *de Gen.*, d. 7, q. 2 ; Aguirre, *de Gen.*, d. 55. (45) Cf. Aguirre, *de Gen.*, d. 55, s. 2, n. 26. (46) Scotus, 4, dist. 12, q. 4. (47) Marsilius, 4, dist. 12, q. 9, a. 2 ; Gotifredus, *Quodl.*, 11, q. 3 ; Pomponatius, *de Augmentat*, 2, c. 10. (48) Phil. Faber, in 4, d. 40 ; Bassil., q. 3, a. 2 ; Cajetan, in iii, q. 77, a. 5 ; Hispalensis, 2, dist. 18, q. 1 ; Toletus, *Phys.*, 4, q. 11. (49) Ockham, *de Euchar.*, Gabriel, *in Canon.*, lect. 45 ; Vallesius, *Phys.*, 4, text 84 ; do., *Contr.*, q. 27 ; Oviedo, *de Gen.*, contr. 7, punct. 5 ; Arriaga, *Phys.*, d. 16, s. 6 ; Soares, *de Gen.*: d. 3, s. 7, par. 3 ; Pontius, *C.P.*, d. 50, q. ult., concl. 5.

Artificial Form and Figure :—(50) St. Thos., 3, dist. 16, q. 2, a. 1 ; do., *S. Th.*, iii, q. 45, a. 1, ad. 2 ; do., 4, dist. 1, q. 1, q. 1, a 3, ad. 2 ; do., *S. Th.*, i, q. 7, a. 1, ad. 2 ; do., *S. Th.*, i, q. 7, a. 3 ; do., *Phys.*, 7, lect. 5 ; do., *Met.* 5., lect. 8 ; do., *S. Th.*, ii, 2, q. 96, a. 2, ad. 2 ; do., *c. Gentes*, 2, c. 76 ; do., *c. Gentes*, 3, c. 105 ; Cajetan and Ferrar.,—*his locis ;* Scotus, 4, dist. 1, q. 4 ; Suarez, *D.M.*, d. 18, s. 4, nn. 8, 9 ; do., *D.M.*, d. 42, s. 6, n. 5 ; Conimbric., *Log.*, q. 1, de Qual., a. 3.

Virtual or Occult Qualities :—(51) St. Thos., *de Occultis Operibus Naturæ ;* do., *Q. de An.*, a. 1 ; do., 2, dist. 15, q. 1 ; do., *de Cœlo*, 2, lect. 10 ; Albert. M., 2, dist. 15, q. 1 ; Suarez, *D.M.*, d. 22, sec. 5, n. 15 ; Scotus, 2, dist. 14, q. 3 ; Conimbric., *Meteor.*, tr. 13, c. 2 ; Rubius, *de Cœlo*, 2, q. 2; Pontius, *C.P.*, d. 53, q. ult., concl. 2 ; Aguirre, *de Cœlo*, d. 73, n. 59 ; Soares, *de Cœlo*, d. 5, s. 2, subsec. 8 ; Tolet., *de Gen.*, 2, c. 3, q. 3.

Impetus :—(52) Arist., *de Cœlo*, 3, c. 2, t. 28 ; do., *Phys.*, 8, c. 10, t. 82 ; do., *de Insomniis*, c. 2 ; do., *de Divinatione*, etc., c. 1 ; do., *Problem.*, sec. 11, probl. 6 ; do., *in Mech.*, q. 33 ; St. Thos., *de Cœlo*, 3, lect. 7 ; do., *de Cœlo*, 2, lect. 8 ; do., *Phys.*, 8, lect. 22 ; do., *S. Th.*, i, 2, q. 23, a. 4 ; do., *S. Th.*, i, 2, q. 26, a. 2 ; do., *Quæst. disp. de Spe*, a. 3 ; Scotus (?), *Phys.*, 8, q. 3. (53) Capreolus, 4, dist. 1, q. 1 ; Sotus, *Phys.*, 8, q. 3 ; John of St. Thos., *Phil. Nat.*, i, q. 23, a. 2 ; Roselli, *Summa Phil.*, 2, q. 25, a. 4 ; Vasquez, in i, d. 91, c. 2 ; Suarez, *D.M.*, d. 35, s. 6, n. 24 ; Conimbric., *Phys.*, 7, c. 2, q. 1, a. 8 ; Pontius, *C.P.*, d. 49, q. 1 ; Aversa, q. 40, s. 6 ; Frassen, *Phil. Ac.*, Phys., 2, d. 1, s. 3, q. 1 ; Soares, *Phys.*, tr. 3, d. 3, sec. 1 ; Oviedo, *Phys.*, contr. 20, punct. 2. (54) St. Thos., *de Pot.*, q. 3, a. 11, ad. 5 ; do., *Q. de An.*, a. 11, ad. 2. (55) Maior, 2, dist. 13, q. 7 ; Burlæus, *Phys.*, 8, t. 70 ; Mairon, 1, dist. 22, q. 7 ; Pererius, *Phys.*, l. 14, c. 5.

The Intensification and Remission of Material Qualities :—(56) St. Thos., *S. Th.*, i, 2, q. 52, a. 1 ; do., *de Virt. in comm.*, q.1, a. 11 ; do., *Phys.*, 4, lect. 14 ; do., 1, dist. 17, q. 2, a. 2 ; do., *S. Th.*, ii, 2, q. 24, a. 5 ; do., *Tot. Log. S.*, tr. 2, c. 4. (57) Cajetan, in i, 2, q. 52, a. 1 ; do., in ii, 2, q. 24, a. 5 ; do., i, 2, q. 54, a. 4 ; Capreol., 1, dist. 27, q. 2 ; Hervæus, 1, dist. 27, q. 5 ; do., *Quodl.*, 5, q. 5 ; do., *Quodl.*, 6, q. 11 ; Soncin., *Met.*, 8, q. 21 ; Complut., *de Gen.*, d. 4, q. 9 ; Goudin, *Phys.*, 3, q. 2, a. 1 ; Aegid., *Quodl.*, 2, q. 14 ; Astudillo, *de Gen.*, 1, q. 8 ; Henric., *Quodl.*, 5, q. 5 ; do., *Quodl.*, 9, q. 13 ; Sotus, *in Præd.*, c. de qualitate ; do., *Phys.*, 4, t. 84. (58) John of St. Thos., *de Gen.*, q. 4, a. 2 ; Babenst., *de Gen.*, d. 3, a. 2, sec. 2 ; Suarez, *D.M.*, d. 46, sec. 1. (59) 1, dist. 17, q. 7 ; Gofred., *Quodl.*, 11, q. 3 ; Albert. a Nipho, *Met.*, 8, d. 11, c. 3. (60) Scotus, 1, dist. 17, qq. 3, 4 ; Pontius, *C. Phil.*, d. 51, qq. 3, 4, 5 ; Frassen, *Phil. Acad.*, Phys., 2, d. 1, a. 3, q. 2 ; St. Bonav., 1, dist. 17, p. 2, a. 1, q. 2 ; Ockham, 1, dist. 17, q. 6 ; Tolet., *de Gen.*, 1, c. 3, q. 4 ; Suarez, *D.M.*, d. 46, sec. 1 ; Vasquez, in i, 2, d. 82, c. 3 ; Fonseca, *Met.*, 8, c. 3, q. 2, sec. 3 ; Soares, *Met.*, tr. 4, d. 2, sec. 2.

The Fact of Finite Activity :—(61) St. Thos., 2, dist. 1, q. 1, a. 4 ; do., *c. Gentes.*, 3, c. 69 ; do., *de Verit.*, q. 5, a. 9, ad. 4 ; do., *S. Th.*, i, q. 105, a. 5 ; do., *de Pot.*, q. 3, a. 7 ; Albert. M., *Phys.*, 2, tr. 2, c. 5 ; Durandus, Hervæus, Aegidius, etc., 2, dist. 18 ; Capreol., 1, dist. 42, a. 3 ; Rubius, *Phys.*, 2, c. 3 ; Amicus, *Phys.*, tr. 11, q. 6, dub. 2, a. 3 ; Suarez, *D.M.*, d. 18, sec. 1 ; Soares, *Phys.*, tr. 2, d. 4, sec. 1 ; Conimbric., *Phys.*, 2, c. 7, q. 11 ; Peter d'Ailly, 4, dist. 1, q. 10 ; do., 4, dist. 2, q. 1 ; Oviedo, *Phys.*, controv. 9, punct. 2.

The Active Qualities of Matter :—(62) St. Thom., *S. Th.*, ii, 2, q. 96, a. 2, ad. 2 ; do., *c. Gentes*, 2, c. 76 ; do., *c. Gentes*, 3, c. 105 ; Cajetan and Ferrar., his locis ; Scotus, 4, dist. 1, q. 4 ; Suarez, *D.M.*, d. 18, sec. 5. (63) St. Thos., *de Gen.*, 2, lects. 2, 3, 4, 6 ; do., *de Sens.*, lect. 10 ; do., *Meteor.*, 4, lects. 1, 2, 7, 8 ; do., *de An.*, 2, lect. 13 ; do., *de Cœlo*, 2, lect. 10 ; do., *Phys.*, i, lect. 10 ; John of St. Thos., *Phil. Nat.*, 2, q. 10, aa. 1, 2 ; Conimbric., *de Gen.*, 2, c. 3, qq. 2, 3 ; Pontius, *C.P.*, d. 56, q. 3 ; Soares, *de Gen.*, d. 4, sec. 2 ; Oviedo, *de Gen.*, controv. 8, punct. 5 ; Aguirre, *P.R.*, d. 59.

Transeunt Causality a Making not a Migration of Realities :—(64) St. Thos., 2, dist. 1, q. 1, a. 2, sol. ; cf. also, *c. Gentes*, 2, cc. 17, 18, 19, 21. (65) St. Thos., *S. Th.*, i, q. 115, a. 1, ad. 3. (66) *S. Th.*, i, q. 115, a. 1, ad. 5. (67) *c. Gentes*, 3, c. 69 ; *de Pot.*, q. 3, a. 8 ; *de Verit.*, q. 5, a. 9, ad. 4. (68) St. Thos., *Met.*, 5, lects. 1, 3 ; do., *Phys.*, 1, lect. 1 ; do., *de Verit.*, q. 23, a. 5, ad. 1 ; do., 1, dist. 29, q. 1, a. 1 ; do., *de Pot.*, q. 10, a. 1, ad. 8 ; do., *Phys.*, 2, lects. 1, 5 ; do., *Op. de Princ. Nat.* ; do., *S. Th.*, i, q. 105, a. 5 ; do., *S. Th.*, i, q. 44, a. 2 ; do., *c. Gentes*, 2, c. 16 ; do., *Phys.*, 3, lects. 1, 2 ; Scotus, 4, dist. 12, q. 3 ; Aegidius, *Quodl.*, 3, q. 1 ; do., *Theor.*, 43 ; Pontius, *Phys.*, 2, d. 38 ; Suarez, *D.M.*, d. 18 ; Rubius, *Phys.*, 2, tr. 4, q. 2 ; Hurtado, *Phys.*, d. 9, sec. 2 ; Toletus, *Phys.*, 2, c. 3 ; Arriaga, *Phys.*, d. 11, s. 2, subsec. 4 ; cf., also, references in note (61). (69) St. Thos., *Phys.*, 3, lect. 4 ; do., *de Gen.*, i, lects. 17, 20, 25 ; do., *S. Th.*, i, q. 51, a. 2, ad. 1.

The History of a Phrase :—(70) Arist., *Phys.*, 202^b 6-7 ; do., *Phys.*, 3, c. 3 ; St. Thos., *Phys.*, 3, lect. 5. (71) St. Thos., *Phys.*, 3, lects. 1, 3, 4, 5 ; do., *Met.*, 9, lect. 8 ; do., *S. Th.*, i, q. 41, a. 1, ad. 2 and 3 ; do., *c. Gent.*, 2, c. 73, n. 4 ; do., *S. Th.*, i, q. 45, a. 2, ad. 2 ; do., 1, dist. 40, q. 1, a. 1 ; do., *de Pot.*, q. 3, a. 2 ; do., 1, dist. 32, q. 1, a. 1 ; do., 3, dist. 8, q. 1, a. 5 ; do.,

de Pot., q. 7, aa. 8, 9; do., *S. Th.*, i, q. 28, a. 3; do., *S. Th.*, i, q. 45, a. 3; do., 4, dist. 46, q. 2, a. 2, sol. 3; do., 4, dist. 1, q. 1, a. 4, sol. a, ad. 1; do., *S. Th.*, i, q. 23, a. 2, ad. 1; do., *de An.*, 3, lect. 2; do., *Met.*, 11, lect. 9; do., *Phys.*, 7, lect. 4; do., *c. Gentes*, 2, c. 23; do., *de Pot.*, q. 10, a. 1; do., *de Pot.*, q. 8, a. 3; do., *de Verit.*, q. 4, a. 2, ad. 7; do., 2, dist. 40, q. 1, a. 4, ad. 1. (72) Scotus, 4, dist. 13, q. 1; do., *Quodl.*, 13; Ant. Andreas, *de Sex Princip.*, c. de Actione; P. Venet., *Summa*, Phys., c. 18; Pontius, *C.P.*, d. 17, q. 3; Mastrius, *Phys.*, d. 7, q. 3, a. 2. (73) Ockham, 1, dist. 3, q. 2; Gabriel, 1, dist. 30; Gregory, 1, dist. 28, q. 2; Aliaco, in 1, q. 7; Wadding, *de Incarn.*, d. 1, dub. 3; Martinon, *de Deo*, d. 22, sec. 2; Toletus, *Phys.*, 3, q. 3, a. 2; Sotus, *Phys.*, q. 2. (74) Capreolus, 2, dist. 1, q. 2, a. 3; do., 4, dist. 49, q. 1, a. 3; Hervæus, *Quodl.*, 4; Soncinas, *Met.*, 5, q. 37; Javellus, *Met.*, 9, q. 15; Complut., *Phys.*, d. 17, q. 4; Conimbric., *Phys.*, 3, c. 3, q. 1; Suarez, *D.M.*, d. 48; Soares, *Met.*, tr. 6, d. 1. (75) in i, q. 25; Hispalen., 1, dist. 27, q. 1, n. 3; Flandr., *Met.*, 5, q. 22. (76) John of St. Thos., *Phys.*, q. 14, a. 4; Goudin, *Phys.*, i, d. 3, q. 1, a. 2.

Contact as a Condition of Action:—(77) St. Thos., *Phys.*, 4, lects. 10, 11, 14; do., *de Cœlo*, i, lects. 20, 21; do., 2, dist. 1, q. 1, a. 5; Conimbric., *Phys.*, 4, c. 9, q. 1, a. 4; Soares, *Phys.*, 5, d. 2, sec. 1. (78) St. Thos., *Phys.*, 7, lect. 3; do., *de Gen.*, i, lects. 18, 23; do., *c. Gentes*, 3, c. 68, n. 4; do., *de Pot.*, q. 3, a. 9; do., 4, dist. 49, q. 2, a. 3, ad. 6; do., 2, dist. 15, q. 1, a. 2, ad. 6; do., *S. Th.*, i, q. 105, a. 2, ad. 1; do., 3 *c. Gentes*, 2, c. 56; do., *de Cœlo*, 3, lect. 7; do., *de An.*, 2, lect. 15; do., *de Gen.*, lect. 16; Cajetan and Ferrar., locis citatis, *S. Th., et c. Gentes*; Capreolus, 1, dist. 37; Durandus, 1, dist. 37, q. 1; Suarez, *D.M.*, d. 18, sec. 8; Complut., *Phys.*, d. 18, a. 3; Aguirre, *Phys.*, 7, d. 39; Conimbric., *Phys.*, 7, c. 2, q. 1; Sotus, *Phys.*, 7, q. 1; Soares, *Phys.*, 2, d. 4, sec. 4; John of St. Thos., *Phys.*, q. 22, a. 2; Compton, *Phil. Univ.*, d. 36. (79) Ockham, 1, dist. 37; Scotus, 1, dist. 37; Gabriel, Bassol., Mairon, Lichet., ibidem; Camerarius, p. 2, q. 2; Mastrius, *Phys.*, d. 7, q. 4, a. 3; Pontius, *Phys.*, 7, d. 48, q. 2; Cabeus, *Meteor.*, 4, fol. 129. Some authors contest the attribution of this opinion to Scotus—cf. Compton and Aguirre, *loc. cit.*: wrongly, I think. Pontius and others made a distinction between total causality and partial causality that does not affect the main issue. (80) *Phil. Peripat.*, 2, d. 10, q. 1, sec. 5.

Unlikeness as a Condition of Action:—(81) Arist., *de Gen.*, i, cc. 7, 8, 9; do., *Phys.*, l. 1; do., *Phys.*, 3, t. 15; do., *Met.*, 5, c. 12, t. 17. (82) St. Thos., *de Gen.*, 1, lects. 19, 22; do., *Phys.*, 8, lect. 21; do., *Meteor.*, i, lects. 14, 16; do., *Phys.*, 3, lect. 5; do., *Met.* 11, lect. 9; do., *Met.*, 9, lect. 1; do., *S. Th.*, i, q. 84, aa. 1, 2, 3; do., *S. Th.*, i, 2, q. 85, a. 1, ad. 4; do., *S. Th.*, ii, 2, q. 59, a. 3; Bannes, *de Gen.*, c. 9, q. 2; John of St. Thos., *Phys.*, 2, q. 5, a. 2; Goudin, *Phys.*, 1, d. 3, q. 6, a. 1; Conimbric, *de Gen.*, 1, c. 9, q. 2; Complut., *Phys.*, d. 8, q. 1; Suarez, *D.M.*, d. 18, sec. 9; Soares, *Phys.*, tr. 2, d. 4, sec. 5; Pontius, *C.P.*, d. 54, q. 1; Arriaga, *de Gen.*, d. 3, sec. 7; Hurtado, *Phys.*, d. 9, sec. 9; Aguirre, *de Gen.*, d. 56. (83) Tolet., *de Gen.*, i, c. 7, q. 13; Marsilius, *de Gen.*, 1, q. 18; Niphus, *de Gen.*, c. 2, q. 2; Soto, *Phys.*, 2, q. 4.

One of the chief ambitions of Descartes was to introduce the Democritean theory of material quality and of transeunt causality into the Catholic Schools. Kineticism in matter seemed to him the best basis for Physics and for Cosmology. He admitted, however, that Democritean kineticism could be made philosophically consistent only when connected up with Occasionalism. What Descartes proposed to do in Physics and in Cosmology, his followers carried out everywhere in Philosophy and in Theology. This propagandism of the Cartesians made kineticism the storm-centre of Catholic speculation during the seventeenth and eighteenth centuries in France and the Netherlands and—to a less extent—in Germany and Italy (cf. Bouillier, *Histoire de la Philosophie Cartesienne*, 1854). But by the close of the eighteenth century, kineticism had been definitely set aside in Philosophy and Theology by the overwhelming majority of Catholic thinkers. Those who are conversant with the details of these long and bitter controversies on the continent will find little new in the late Dr. McDonald's *Motion, Its Origin and Conservation* (1898). Of these controversies, those that concern Cosmology are the two dealing with the kinetic explanation of the qualities of matter and the kinetic explanation of

transeunt causality: and in the subsequent volume on Modern Cosmology, the revival in this connexion of Democritus by the Cartesians and by Dr. McDonald will engage our attention for the purpose of examining whether these moderns have added anything to the arguments for those Democritean theories which were set aside, centuries ago, as unconvincing by Aristotle and by St. Thomas.

One original thesis in *Motion* is the author's contention (cc. 2, 3, 4) that Aristotle and St. Thomas were, in Cosmology, kineticists. The student who goes to the trouble of verifying the Aristotelian and Thomistic texts quoted in the eighth and ninth chapters of the present volume will be convinced, I trust, of the utter inaccuracy of this contention.

The general reader to whom this patient collation of texts is caviare can, if he has at hand the writings of Aristotle and of St. Thomas, satisfy himself in an hour or two as to the value of the evidence adduced by our author in favour of this amazing myth. One of Dr. McDonald's strong points is that neither Aristotle nor St. Thomas has left us in the *Physics* any statement or any dissertation on force as distinct from local motion. This is as convincing an argument against the existence of such a statement or dissertation in Aristotle and St. Thomas, as would be an argument against the existence of London on the map based on the fact that this city is not marked on a map of South America. The *Physics*, to which Dr. McDonald refers, is but one of a dozen Aristotelian treatises dealing with bodies and their activities. Now, several of these other treatises contain lengthy and exhaustive dissertations against the kineticism of Democritus, and in favour of the existence of indwelling forces distinct from local motion: Aristotle, *de Generatione et Corruptione*, *de Anima* (2nd book), *Parva Naturalia* (*de Sensu et Sensili*), and, also, to some extent, *de Cœlo*, *de Mundo;* St. Thomas, *de Generatione et Corruptione*, *de Anima* (2nd book), *de Sensu et Sensato*, *de Cœlo et Mundo*. When the general reader has verified these facts for himself, he will naturally grow suspicious about the statement (p. 27) that Aristotle "rarely if ever" uses the word, *δύναμις*, in the sense of force as distinct from local motion: let him open the Index of the Berlin edition (1830-1870) of Aristotle, and he will learn that this word generally means in Aristotle either force or passive potency, and that it is employed more than 150 times for force but less than 80 times for passive potency. All these discoveries will prepare the reader to see through the ruse of discussing St. Thomas's use of the word, force, solely from the standpoint of the word, *virtus*, and its two meanings: St. Thomas, in the series of Commentaries mentioned above, speaks bluntly of *qualitates activæ*, and insists everywhere on the existence of active qualities distinct from local motion—in other words, of that kind of force which is such a metaphysical scandal to all kineticists.

So much for the written testimony of Aristotle and of St. Thomas on the first plank of the kinetic platform in Cosmology. The second plank of that platform is that transeunt causality between bodies consists in a flow of local motion from the agent to the patient. Dr. McDonald is not quite so confident that Aristotle and St. Thomas accepted this plank of the kinetic platform. He urges, however, that only men of straw refuse this particular plank: "But it is altogether too manifest that agents are in some way the subjects of their transient actions—while these motions are in the agents and before they have been transferred (p. 207)". And as no Catholic reader would think of Aristotle and St. Thomas as men of straw, the unwary are led to believe that Aristotle and St. Thomas interpreted transeunt causality as a flow of motion. However manifest such a view may have been to the author of *Motion*, it was rejected in the most formal manner both by Aristotle and by St. Thomas. But Dr. McDonald takes good care not to put before his readers these explicit denials of the flow of motion theory of causality. He fights shy of the three famous texts in which St. Thomas scoffs at those who interpret transeunt causality as a flow of anything from agent to patient: *c. Gentes*, 3, c. 69; *de Pot.*, q. 3, a. 8; *de Verit.*, q. 5, a. 9, ad. 4. And his attitude to Aristotle on this topic takes one's breath away. So lengthy are his quotations from, and his discussions on, the three opening chapters of the third Book of the *Physics* that he feels it necessary to apologise (p. 25): and yet, despite these lengthy quotations and exhaustive discussions, he has the nerve to omit to quote from the third chapter the particular sentence in which Aristotle explicitly disavows

the kinetic interpretation, advocated by Dr. McDonald himself, of the troublesome phrase—action and passion are one and the same " motion ": *ἔστι γὰρ ἡ δίδαξις ἐνέργεια τοῦ δ.δασκαλικοῦ, ἔν τινι μέντοι, καὶ οὐκ ἀποτετμημένη, ἀλλὰ τοῦδε ἐν τῷδε* (202^{b} 7-8). Then, notwithstanding a grave omission of this kind, our author speaks of these chapters as "the basis of the whole Aristotelic system of Physics," uses the opening sentence of that third chapter as the first motto on his title-page, employs the much-discussed phrase about action and passion as a Thomistic quotation for his second motto, declares this phrase " axiomatic in the Catholic Schools " : thereby, attributing, to Aristotle and to St. Thomas, with a wealth of emphasis on a fundamental and far-reaching problem, a view which both of them reject explicitly and formally again and again.

CHAPTER IX.

The Ambiguity of the Medieval Term, Motion :—(1) *Phys.*, 3, cc. 1, 2 ; do., *Phys.*, 5, c. 2 ; St. Thos., *Phys.*, 3, lects. 1, 2 ; do., *Phys.*, 5, lects. 2, 3, 4 ; Scotus (?), *Phys.*, 3, Expos. Text., 5 ; do., *Phys.*, 5, qq. 1, 2, 3, 4. (2) *S. Th.*, i, q. 67, a. 2, ad. 3 ; cf. *S. Th.*, i, 2, q. 7, a. 1. (3) St. Thos., *Phys.*, 3, lect. 2.

The Transcendental Meaning of Potency and Actuality :—(4) Arist., *Met.*, 5, c. 12 ; do., *Met.*, 9, *passim ;* do., *de An.*, 2, c. 5 ; do., *Met.*, 5, c. 7 ; do., *Met.*, 12, c. 5 ; St. Thos., *de An.*, 2, lect. 11 ; do., *Met.*, 5, lects. 9, 14 ; do., *Met.*, 9, lects. 1, 9 ; do., *Met.*, 12, lect. 4 ; do., *Phys.*, 1, lect. 15 ; do., 4, dist. 4, q. 1, a. 1 ; do., *Summa T. Log.*, tr. 4, c. 3 ; do., *de Pot.*, q. 3, a. 1 ; Scotus, *Met.*, 9, Summæ, i, ii ; do., *Quæst. Met.*, 9, qq. 1-10 ; Suarez, *D.M.*, d. 20, s. 1 ; do., d. 18, sec. 3 ; do., d. 43, sec. 2 ; do., d. 31, sec. 3 ; do., dd. 43, 13, 15. (5) The problem of applying this definition to primordial matter led to a controversy between the Thomists and the Scotists : cf. Chapter v—A War of Words, (6) *Met.*, 9, 1048^{a} 27-1048^{b} 5. (7) St. Thos., Met., 9, lect. 5. (8) Arist., *Met.*, 5, c. 12 ; do., *Met.*, 9, c. 7 ; St. Thos., *Met.*, 5, lect. 14 ; do., *Met.*, 9, lect. 6.

The Medieval Definition of Physical Motion :—(9) *Phys.*, 3, lect. 2, (10) *Phys.*, 3, c. 2. (11) Arist., *Phys.*, 3, 201^{b} 4 ; do., *Met.*, 10, 1065^{b} 16 ; do., *Phys.*, 3, 202^{a} 7 ; do., *Phys.*, 8, 251^{a} 9 ; do., *Phys.*, 3, 202^{b} 26 ; do., *Phys.*, 3, 201^{a} 9. (12) St. Thos., *Phys.*, 3, lect. 2. Cf. also S. Thos., *Met.*, 11. lect. 9 ; do., *Phys.*, 3, lect. 3 ; Scotus, *Met.*, 11, s. 4, c. 1 ; do., 2, dist. 12, q. 1 ; Suarez, *D.M.*, d. 49, sec. 2 ; Pontius, d. 52, q. 1 ; Conimbric., *Phys.*, 3, c. 2, q. 1 ; Fonseca, *Met.*, 5, c. 13, q. 9, s. 2 ; Cabeus, *Meteor.*, 2, t. 56, q. 2 ; Tolet., *Phys.*, 3, c. 2, t. 6 ; Hurtado, *Phys.*, d. 11, s. 1 ; Oviedo, *Controv.*, 12, p. 6, n. 5 ; Soares, *Phys.*, tr. 3, d. 1, sec. 1 ; John of St. Thos., *Phys.*, q. 14, a. 1 ; Aguirre, *Phys.*, 3, d. 19, sec. 1.

The Motion of Generation or Corruption :—(13) Arist., *Phys.*, 5' cc. 2, 5 ; do., *Met.*, 11, c. 10 ; do., *Phys.*, 4, cc. 11, 12 ; do., *Phys.*, 6, cc. 2, 4, 5 ; do., *Phys.*, 3, cc. 1, 2 ; St. Thos., *Met.*, 12, lect. 5 ; do., *Phys.*, 4, lect. 17 ; do., *Met.*, 11, lect. 9 ; do., *de Gen.*, 1, lect. 24 ; do., *Phys.*, 6, lects. 3, 8 ; do., *Phys.*, 5, lects. 2, 3, 8 ; do., *Phys.*, 3, lect. 1 ; do., 2, dist. 5, q. 2, a. 1 ; do., *de Gen.*, 1, lect. 10 ; do., *de Sens.*, lect. 16 ; do., *S. Th.*, i, q. 67, a. 2 ; do., *S. Th.*, i, q. 46, a. 3 ; do., i, dist. 8, q. 3, a. 3 ; Scotus, 2, dist. 2, q. 2 ; Mastrius, *de Gen.*, d. 3, q. 5 ; Aegidius, *de Gen.*, 1, q. 16 ; Conimbric., *Phys.*, 5, c. 1, q. 1, a. 3 ; do., *Phys.*, 3, c. 2, q. 2, a. 1 ; Fonseca, *Met.*, 5, c. 15, q. 9, s. 4 ; Soares, *Phys.*, 3, d. 1, sec. 1 ; Pontius, d. 53, q. 2 ; Toletus, *de Gen.*, 1, q. 6 ; Sotus, *Phys.*, 3, q. 1 ; Javellus, *Phys.*, 8, q. 8 ; Pereira, *de Communibus*, 13, cc. 58 and 14, c. 6 ; John of St. Thos., *Phys.*, 1, q. 14, a. 1 ; do., *Phys.*, 2, q. 3, a. 3 ; Aguirre, *de Gen.*, d. 54, sec. 2 ; Suarez, *D.M.*, d. 46, sec. 3 ; Complut., *de Gen.*, d. 2, q. 10 ; Babenstuber, *de Gen.*, d. 3, a. 1. (14) Arist., *Phys.*, 3, cc. 1, 2 ; St. Thos., *Phys.*, 3, lects. 2, 3 ; do., *Phys.*, 5, lects. 1, 2 ; Scotus, 2, dist. 12, q. 1 ; Suarez, *D.M.*, d. 49, sec. 2 ; Complut., *Phys.*, d. 49, q. 2, n. 16 ; John of St. Thos., *Phys.*, q. 14, a. 1 ; Mastrius, *Phys.*, d. 15, q. 5 ; Pontius, *Phys.*, d. 42, q. 1 ; Aguirre, *Phys.*, 3, d. 19, sec. 1 ; Soares, *Phys.*, 3, d. 1, sec. 2.

The Motion of Augmentation or Diminution :—(15) Arist., *de Gen.*, 1, cc. 4, 5 ; do., *Phys.*, 5, cc. 1, 2, 3, 4 ; do., *Phys.*, 4, cc. 4, 14 ; do., *de An.*, 2, c. 4 ; do., *de Gen.*, 2, c. 2 ; do., *Phys.*, 7, c. 2 ; do., *Phys.*, 6, c. 5 ; St. Thos.,

de Gen., 1, lects. 10, 11, 13, 14, 15, 16, 17; do., *Phys.*, 5, lects. 2, 3, 4; do., *Phys.*, 3, lect. 2; do., *Phys.*, 4, lect. 5; do., *de An.*, 2, lects. 3, 8, 9; do., *de Cœlo*, 1, lect. 7; do., *Phys.*, 6, lect. 8; do., *Phys.*, 7, lect. 4; do., *Phys.*, 8, lect. 14; do., *S. Th.*, i, q. 118, a. 2, ad. 2; do., *S. Th.*, i, q. 113, a. 1, ad. 2; do., *c. Gentes*, c. 89; do., 2, dist. 30, q. 2, a. 1; do., *Quodl.*, 8, a. 5; Scotus, 1, dist. 47, q. 1; Scotus, 4, dist. 44, qq. 1, 2; Pontius, *C.P.*, d. 45, qq. 1-5; Conimbric., *Phys.*, 5, c. 2, q. 1, aa. 1, 4; Complut., *Phys.*, d. 22, a. 2; Aguirre, *Phys.*, d. 32, secs. 1, 2; do., *de Gen.*, d. 35; Suarez, *de An.*, 2, c. 6; John of St. Thos., *Phys.*, 2, q. 7; Soares, *de Gen.*, d. 2.

The Motion of Alteration:—(16) Arist., *de Gen.*, 1, cc. 4, 5, 8; do., *Phys.*, 7, cc. 2, 3; do., *Phys.*, 5, cc. 2, 4, 5; do., *Phys.*, 4, c. 9; do., *Phys.*, 8, c. 3; do., *Phys.*, 6, cc. 3, 5, 10, 11; do., *Phys.*, 3, c. 1; do., *de Cœlo*, 3, c. 1; do., *de Sens.*, c. 6; St. Thos., *de Gen.*, 1, lects. 10, 14; do., *Phys.*, 7, lects. 4, 5, 6; do., *de Cœlo*, 1, lect. 7; do., *Phys.*, 3, lect. 1; do., *Phys.*, 5, lects. 4, 6, 7, 8; do., *Phys.*, 6, lects. 5, 7, 8, 9; do., *de Sens.*, lect. 16; do., *Quodl.*, 9, a. 9; do., 2, dist. 5, q. 2, a. 1; do., 2, dist. 13, q. 1, a. 3, ad. 9; do., 4, dist. 17, q. 1, a. 2, sol. 1; do., *Phys.*, 8, lects. 14, 17; do., *de Verit.*, q. 28, a. 1; do., *Phys.*, 4, lect. 14; do., *de Cœlo*, 3, lect. 3; do., *Met.*, 5, lect. 15; Scotus, 2, dist. 2, qq. 2, 9; do., 1, dist. 17, q. 4; do., 3, dist. 13; do., 1, dist. 19, q. 4; Pontius, *C.P.*, d. 43, qq. 1-7; John of St. Thos., *Phys.*, 2, q. 3, aa. 1, 2, 3; Conimbric., *de Gen.*, 1, c. 4, qq. 1, 2, 3, 4; do., *Phys.*, 7, c. 3, q. 1; Aguirre, *Phys.*, d. 32, sec. 3; do., *de Gen.*, d. 54, secs. 1-4; Soares, *de Gen.*, d. 2.

Local Motion:—(17) Soares, *Met.*, 7, d. 1, sec. 1. (18) Arist., *Phys.*, 4, cc. 1, 3, 7; do., *Phys.*, 4, cc. 1, 4, 5; do., *Phys.*, 3, c. 1; do., *Phys.*, 5, c. 1; do., *Phys.*, 8, c. 7; do., *Phys.*, 4, cc. 1, 5, 6, 7, 8; do., *Met.*, 11, c. 7; St. Thos., *Phys.*, 3, lects. 1, 2; do., *Phys.*, 7, lect. 3; do., *Phys.*, 5, lects. 2, 5; do., *Phys.*, 8, lect. 14; do., *Met.*, 12, lect. 7; do., *Phys.*, 1, lect. 13; do., *de Cœlo*, 4, lect. 2; do., *de Gen.*, 1, lect. 18; do., *de Cœlo*, 1, lect. 20; do., *de Gen.*, 2, lect. 2; do., *S. Th.*, i, q. 110, a. 3; do., *de Pot.*, q. 6, a. 3; do., *de Malo*, q. 16, a. 10; do., 2, dist. 12, q. 1, a. 1, ad. 5; do., *de Verit.*, q. 26, a. 1; do., 4, dist. 47, q. 2, a. 2, sol. 1; do., 4, dist. 11, q. 1, a. 3, sol. 1, et ad. 3; do., 4, dist. 44, q. 2, a. 3, sol. 2, ad. 1; do., 3, dist. 22, q. 3, a. 1, ad. 1; do., *Quodl.*, 6, a. 3; do., *de Nat. Loci*; do., *de T. Logicæ S.*, tr. 5, cc. de Ubi; do., *c. Gentes*, 3, c. 82; Scotus, *Quodl.*, 11; Scotus (?), *Phys.*, 3, c. 3, q. 2; Scotus, 4, dist. 49, q. 16; Pontius, *C.P.*, d. 17, q. 6; do., *Phys.*, 4, d. 45, q. 1; Wadding, *de Incarn.*, d. 4, n. 49; Fasol., i, q. 10, a. 1, n. 24; Aegidius, *de Sacram.*, q. 75, a. 4, dub. 1; Gilbert Porret., *de Sex Princ.*; Soto, *Prædic.*, c. 9; Fonseca, *Met.*, 5, c. 15, q. 7, s. 3; Amicus, *de Angelis*, d. 5, s. 2, n. 46; Babenstuber, *Phys.*, 4, d. 1, a. 3; Bellarmine, *de Euch.*, 3, c. 3; do., *de Euch.*, 4, c. 15; Salas, in i, 2, t. 1, tr. 1, d. 3, sec. 2; Tolet., *Logica*, c. de Ubi; do., *Phys.*, 3, c. 3, q. 3; Martinon, *de Deo.*, d. 5, n. 45; Valent., i, d. 4, q. 3, punct. 2; Gregor., 2, dist. 1, q. 4, a. 1; Soncin, *Met.*, 5, q. 40; Hervæus, *Quodl.*, 1, q. 9; Durandus, 2, dist. 15, q. 2; Jandunus, *Met.*, 4, q. 4; Maior, 2, dist. 2, q. 2; Ockham, 2, dist. 2, q. 9; de Rhodes, *Phil. Perip.*, 2, d. 4, s. 3; Tiphanus, *de Hypostasi*, c. 54. (19) Molina, i, q. 52, a. 1; Vasquez, i, d. 188, c. 7; Suarez, *D.M.*, d. 51, secs. 1, 2; do., *de Angelis*, 4, c. 2; Conimbric., *Log.*, c. 9, q. 2, a. 1; do., *Phys.*, 3, c. 3, q. 2, a. 2; Arriaga, *Phys.*, d. 14, s. 2, n. 49; Compton, *Phil. Univ.*, d. 34, s. 3, n. 3; Hurtado, *Phys.*, d. 14, s. 2, n. 9; Lossada, *Curs. Phil.*, 2, tr. 3, d. 2, n. 12; Oviedo, *Phys.*, contr. 15, p. 4, n. 3; Soares, *Met.*, tr. 7, d. 1, secs. 1, 2; John of St. Thos., *Phys.*, 2, q. 16, aa. 2, 3; Goudin, *Logic. Major*, d. 2, q. 6, a. 2; etc., etc. (20) Lahousse, *Cosmol.*, c. 3, a. 2, n. 320. (21) St. Thos., *c. Gentes.*, 3, c. 82. Cf. St. Thos., *c. Gentes*, 2, c. 43; do., *Phys.*, 3, lect. 14; Suarez, *D.M.*, d. 35, s. 6, n. 16; Scotus, 1, dist. 3, q. 7; Conimbric., *Phys.*, 8, c. 7; do., *de Gen.*, q. 3, a. 1; Ferrar., *c. Gentes*, c. 43; do., *c. Gentes*, 3, c. 82.

The Distinction between the Mover and the Moved:—(22) *Phys.*, 7, cc. 1, 2. (23) Arist., *Met.*, 12, t. 35; do., *Phys.*, 7, c. 1; do., *Phys.*, 8, cc. 4, 5; St. Thos., *Phys.*, 7, lects. 1, 3; do., *Phys.*, 8, lects. 7, 8, 9, 10, 22; do., *S. Th.*, i, q. 2, a. 3; do., *S. Th.*, i, 2, q. 36, a. 2; do., *c. Gentes*, 1, c. 13; do., *c. Gentes*, 3, c. 23; do., *de Cœlo*, 3, lect. 7; do., 1, dist. 8, q. 3, a. 1, ad. 3; do., *de Verit.*, q. 22, a. 3; do., *Met.*, 12, lect. 6; do., *Op. de Mot. Cordis*; Cajetan, in i, q. 2, a. 3; Bannes, in i, q. 2, a. 3; Capreol., 1, dist. 3, q. 3; do., 2, dist. 6, q. 1, a. 3; Aegid., *Quodl.*, 3, q. 16; do., *Quodl.*, 2, qq. 16, 17; do., *Quodl.*, 5,

q. 15; Ferrar., *c. Gentes*, 1, c. 13; do., *c. Gentes*, 1, c. 97; do., *c. Gentes*, 3, c. 23; Henric., *Quodl.*, 11, q. 6; Albert., *Phys.*, 8, tr. 2, c. 4; Maior, *de Gen.*, 2, q. 1; do., 1, dist. 17, q. 12; Soncin., *Met.*, 9, q. 7; Conimbric., *Phys.*, 7, c. 1, q. 1; Complut., *Phys.*, 8, d. 28, q. 2; Maurus, *Quæst. Phil.*, P-M., q. 8; Roselli, *Philos.*, 2, q. 23, a. 2. (24) Scotus, 2, dist. 2, qq. 9, 10; do., 1, dist. 3, q. 7, n. 28 sqq.; Lychet., *Comment. in Scotum* h. l.; Scotus (?), *Phys.*, 6, qq. 1, 2, 3; do., *Phys.*, 4, q. 8; do., *Met.*, 2, qq. 4, 5; do., *Met.*, 8, q. 3; do., *Met.*, 9, q. 14; *Comm. in Met. Scoti*, h. l.; Mastrius, *Phys.*, d. 15, q. 8, a. 2; Pontius, *Phys.*, 7, d. 48, q. 1; Mairon, 2, dist. 14, q. 6; Frassen, *Phil. Acad.*, Phys., 2, d. 1, s. 1, q. 4; do., *Phys.*, 2, d. 1, s. 3, q. 2; Jandun., *Phys.*, 8, q. 12; Ant. And., *Met.*, 9, q. 1; Gregor., 2, dist. 6, q. 1, a. 3; Buridan, Niphus, Saxon, etc., *Phys.*, 8. (25) *c. Gentes*, 3, c. 150 (151). (26) Suarez, *D.M.*, d. 18, sec. 7, n. 35. (27) Suarez, *D.M.*, d. 18, sec. 7, n. 35. (28) John of St. Thos., *Phys.*, 1, q. 22, a. 1, ad primum. (29) Goudin, *Phys.*, q. 6, a. 1, ad obj.

Physical Terrestrial Motion and the Heavenly Bodies:—(30) Babenstuber, *de Cœlo*, d. 2, a. 1, s. 5; Aguirre, d. 67, sects. 1, 4; Conimbric., *de Cœlo*, 2, c. 5, q. 1; Soares, *de Cœlo*, d. 2, s. 1; Arist., *de Cœlo*, 2, *passim*; St. Thos., *de Cœlo*, 2, *passim*; do., 2, dist. 14, a. 1; Scotus, 2, dist. 14, q. 2; Lychet., *Comm. in Scot.*, 2, dist. 14, q. 2; Pontius, *Suppl. Scoti*, 2, dist. 14, q. 2; cf. Chapter viii—Astronomy and Alchemy. (31) Arist., *Meteor.*, i, cc. 2, 3; do., *de Cœlo*, 2, cc. 7, 9; do., *Phys.*, 8, c. 9; do., *de Gen.*, 2, cc. 9, 10; do., *Met.*, 2, c. 1; do., *de Gen. An.*, 4, c. 10; St. Thos., *de Pot.*, q. 5, aa. 8, 9, 10; do., *S. Th.*, i, q. 115, aa. 3, 4; do., *S. Th.*, i, 2, q. 9, a. 5; do., *S. Th.*, ii, 2, q. 115, aa. 1-8; do., *S. Th.*, i, q. 104, a. 1; do., *de Verit.*, q. 5, aa. 9, 10; do., *c. Gentes.*, 3, cc. 22, 23, 70, 77, 78, 82-88, 91, 104, 105; do., *c. Gentes.*, 2, c. 15; do. *c. Gentes*, 1, c. 20; do., 2, dist. 2, q. 2, a. 3; do., 2, dist. 15, q. 1, aa. 2, 3; do., *Phys.*, 8, lects. 13, 14; do., *de Cœlo*, 2, lects. 4, 18, 19; do., *de Gen.*, 2, lect. 10; do., *Meteor.*, 1, lect. 2; do., *Met.*, 12, lects. 5, 6; do., *de Motu Cordis*; do., *de Causis*, lect. 3; Cajetan *in S. Th.*, loc. cit.; Ferrar., *in c. Gentes*, loc. cit.; Bannes, *in S. Th.*, i, q. 115, aa. 1-6; Capreol., 2, dist. 14, q. 1; Javellus, *Met.*, 12, q. 13; Soncinas, *Phys.*, 2, q. 4; do., 4, dist. 48, q. a. 2; T. Hurdaton, P.C.M., *Præcursus Phil.*, de Sens., Int., d. 2, c. 13, digressio; Roselli, *Philos.*, 3, q. 15, aa. 1, 2, 3; Aguirre, *de Cœlo*, d. 73, sec. 6; Philipp. a. Trin., *de Cœlo*, q. 6, a. 6; Joannes ab Annunc., *de Cœlo*, d. 4, qq. 3, 4. (32) *c. Gentes*, 2, c. 15. (33) Scotus, 2, dist. 14, q. 3; do., 4, dist. 48, q. 2; Scotus (?), *Phys.*, 8, qq. 2, 7; Pontius, *Suppl. in Scot.*, 2, dist. 14, q. 3; Hiquæus, *Comm. in Scot.*, 4, dist. 48, q. 2; Pitt. Aret., *in Scot. Phys.*, 8, qq. 2, 7; Richard, 2, dist. 14, q. 6, a. 2; Durandus, 2, dist. 14, q. 3; Henricus, *Quodl.*, 11, q. 15; do., *Quodl.*, 14, q. 1; Suarez, *D.M.*, d. 22, sec. 5; Conimbric., *de Cœlo.*, 2, c. 3, q. 4, a. 2; Hurtado, *de Cœl. Propr.*, d. 2, s. 4; Rubius, *de Cœlo*, 2, c. 3, q. 4; Soares, *de Cœlo*, d. 5, s. 2, par. 7; Pontius, *de Cœlo*, d. 51, qq. 9, 10; Frassen, *Phys.*, 3, d. 1, s. 1, pars. 15-21; Arriaga, *de Cœlo*, d. un., n. 65; De Rhodes, *Phil. Perip.*, 2, d. 8, q. 3.

Physical Motion and the Infinite:—(34) *Phys.*, 5, lect. 1. (35) St. Thos., 2, dist. 37, q. 2, a. 2; do., *S. Th.*, i, q. 105, a. 5; do., *S. Th.*, i, 2, q. 109; do., *c. Gentes*, 3, c. 70; Albert. M., 2, dist. 35, a. 7; Scotus, 1, dist. 8, q. 5; do., 2, dist. 1, q. 1; do., 2, dist. 37, q. 2; do., 4, dist. 43; St. Bonaventure, 2, dist. 37, a. 1, q. 1; Suarez, *D.M.*, d. 22. In the twelfth century a number of Schoolmen denied the existence of this immediate concurrence. In the fourteenth and fifteenth centuries another group of dissenters arose: Durandus denied it: Ockham denied that it could be proved philosophically; Gabriel thought the view of Durandus probable; Gregory subscribed to the opposite view merely as more probable. There were dissenters also in the seventeenth century: Lalemandet agreed with Durandus and claimed for that view Præpositivus (a distinguished contemporary of St. Thomas), Varo, Peter d'Auriol, and Peter d'Ailly: Arriaga and Hurtado were inclined to agree with Ockham; Ludovicus à Dola, O.S.F.C., admitted immediate concurrence in non-free actions, but denied it in free actions. Cf. Aguirre, *Phys.*, d. 16, s. 1; Compton, *Phys.*, d. 28, s. 1-3; Babenstuber, *Phys.*, 2, d. 5, s. 1; Lalemandet, *Cursus Philosophicus* (1656, 2nd ed.), pp. 392-408.

CHAPTER X.

A Break with the Tradition of Aristotelian Scholasticism :—(1) De Wulf, *Histoire de la Philosophie Médievale* (1905), pp. 255-407; Ueberweg-Heinze, *Gesch. den. Phil.* (1905), vol. ii, pp. 270-339; Windleband, *History of Philosophy* (1901), pp. 310-346; Erdmann, *History of Philosophy*, vol. i (1898), pp. 356-542; Fr. J. Rickaby, S.J., *Scholasticism*, cc. 4, 5, 6; De Wulf, *Introduction à la Philosophie Neo-Scolastique*, i, c. 3. (2) *Phys.*, 1, tr. 1, c. 1. (3) *Phys.*, 8, tr. 1, c. 14. (4) *S. Th.*, i, q. 1, a. 8, ad. 2. (5) On this controversy between the Schoolmen and the Scientists, cf. Laminne, *Les Quatre Elements.* (6) Sylvester Maurus, *Quæst. Phil.*, l. 3, q. 5; Aguirre, *de Cœlo*, dd. 64-70; Schnell, *Curs. Phil.*, iii, p. 16; Franciscus B. Spei, *Comment. Un. Arist. Phil.*, iii, p. 13; Laurentius, *Curs. Phil.*, ii, p. 274; Van Sichen, *Int. Curs. Phil.*, ii, p. 142; J. Duhamel, *Phil. Univ.*, v, p. 26; Froidmont, *Meteor.*, p. 18; Arriaga, *Cur. Phil.*, p. 356; Pontius, *C. Phil.*, pp. 611-634; do., *C. Phil.*, pp. 690 sqq.; Soares, *de Cœlo*, ii, pp. 271-301; Philip. a. S. Trin., *Summa Phil.*, p. 322; Eustachius a. S. Paulo, *Summa Phil.*, ii, p. 90; Goudin, *Phys.*, ii, d. 1, q. 2, a. 1; Mailhat, *Summa Phil.*, ii, p. 34; Mastrius, *de Gen.*, p. 539; Roselli, iii, pp. 112-207; J. B. Duhamel, *Phil. Vetus et Nova*, ii, pp. 356 sqq.; Jerome de Montefortino, *Summa Scoti*, ii, p. 249; Wenzl, *Phil. Ang.-Thom.*, de Cœlo, q. 1; Amort, *Phil. Poll.*, pp. 745-856; Krisper, *Phil. Sch. Scot.*, p. 321. (7) Sylv. Maurus, *Quæst. Phil.*, iii, q. 48. (8) Goudin, *Phil.*, ii, d. 1, q. 3, a. 1. (9) Ferrari, *Phil. Perip.*, Phys., i, q. 5. (10) Sylv. Maurus, ii, q. 36; Boyvin, *Philos. Scoti*, iii, p. 542; Baro, *Scotus Defensus*, ii, p. 223; Goudin, *Phil.*, ii, q. 3, a. 2; Ferrari, *Phil. Perip.*, ii, p. 229. (11) John of St. Thomas, *C.P. Th.*, iii; Sylv. Maurus, *Quæst. Phil.*, iii; Goudin, *Phil. Thom.*, Phys., iii; Ruvius, *Comm. in Arist. de Gen. Corr.*; Eustachius de St. Paul, *Summa Philos.*; Philip a S. Trinit., *Summa Phil.*; Boyvin, *Phil. Scoti*, iii; A. Laurentius, *de Triplici Ente*; C. Melchoir, *Philosophia*; C. Carleton, *Curs. Phil.*; Complutenses, *Disput. in Arist. Log. et Phil. Nat.*; Mailhat, *Philos.*; Aguirre, *Phil. Rat.*; Hurtado de Mendoza, *Disput. in Un. Phil.* All these belong to the seventeenth century. In the eighteenth century the following support this view: J. Duhamel, *Phil. Univer.*, v; Babenstuber, *Phil. Thom.*, iii; Billuart, *de Opere Sex Dierum*, ii, a. 2; Krisper, *Phil. Schol. Scot.*, Phys., p. 341; Schnell, *Curs. Phil. Arist.-Thom.*, iii, p. 37; Roselli, *Summa Phil.*, 4, q. 17; Buecher, *Prima Phil. Experim. Principia*, etc. In the nineteenth century, the following support this view: P. Puigserver, *Phil. S. Thomæ*; A. Sendil, *de Vera . . . Philosophia*; V. Mareddu, Annotator of Goudin. (12) Arriaga, *C. Phil.*, p. 406; Pontius, *Int. Phil. Curs.*, p. 687; Baro, *Scotus Defensus*, p. 224; N. Arnu, *Dil. Philos. Synt.*; J. B. Duhamel, *Phil. Vetus et Nova*, ii, p. 67. All these are of the seventeenth century. Eighteenth century supporters are: Frassen, *Phil. Acad.*, iii, pp. 85 sqq.; Ferrari, *Phil. Thom.*; Mastrius, *Disput. de Gen. et Corr.*; Agnani, *Phil. Neo-Palæa*; Mangold, *Phil. Rat. et Experim.*; Wenzl, *Phil. Ang.-Thom.*; Amort, *Philos. Polling.* (13) Bouvier, *Instit. Phil.*; Galuppi, *Elementi di Filosofia*; Delalle, *Cours de Phil. Chret.*; Buezinski, *Instit. Philos.*; Blatairon, *Instit. Philos.*; De Decker, *Cours. Elem. de Phil.*; Rattien, *Cours Complet de Phil.*; Brunon, *Elementa Phil.*; Noget, *Instit. Phil.*; Balmes, *Curso de Filosofia Elemental*; Gibon, *Cours de Philos.*; Dameron, *Cours de Phil.*; Rothenflue, *Instit. Phil. Theor.*; Deutinger, *Grundlinien einer posit. Phil.*; Ubaghs, *Elementa Log. et Meta.*; Dmowski, *Instit. Philos.*; Doney, *Nouveaux Elements de Phil.*; H. de Ferrari, *Phil. Thom.* (14) Boscovich, *Theoria Phil. Nat.*; Contzen, *Præl. Met.*; Storchenau, *Instit. Met.*; Horvath, *Instit. Log et Met.*; Bech, *Instit. Met.*; Genovesi, *Elementa Met.*; Ernesti, *Initia Doct. Solidioris*; Palmieri, *Instit. Philos.* (15) Rickaby, S.J., *Scholasticism*, pp. 49, 50.

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